

OLYM

Draft Environmental
Impact Statement

Elwha River
Ecosystem Restoration

Olympic National Park • Washington

October 1994





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Draft Environmental Impact Statement

Elwha River Ecosystem Restoration

Purpose and Need: The Elwha River ecosystem and native anadromous fisheries are severely degraded as a result of two hydroelectric dams and their reservoirs built in the early 1900's. Congress has mandated the full restoration of this ecosystem and its native anadromous fisheries through the Elwha Restoration Act (P.L. 102-495).

Proposed Action: The U.S. Department of the Interior (DOI) proposes to fully restore the Elwha River ecosystem and native anadromous fisheries through the decommission of Elwha Dam and Glines Canyon Dam and removal of all structures necessary, including all or part of both dams, powerhouses, reservoirs and associated facilities to achieve this purpose. The proposed action is located in Clallam County, on the Olympic Peninsula in Washington State.

Lead agency: National Park Service

Cooperating agencies: U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, U.S. Bureau of Indian Affairs, U.S. Army Corps of Engineers, and the Lower Elwha S'Klallam Tribe

Type of statement: This is a draft environmental impact statement (EIS). In preparing this draft EIS, DOI has adopted the majority of a draft environmental impact statement titled "Proposed Elwha (Federal Energy Regulatory Commission (FERC) No. 2683) and Glines Canyon (FERC No. 588) Hydroelectric Projects, Washington" as updated and renamed Draft Staff Report in March 1993 prepared by FERC. DOI has also incorporated the Elwha Report, prepared by the U.S. Departments of the Interior, Commerce and the Lower Elwha S'Klallam Tribe (Jan. 1994) and its appendices, into the legal record for its EIS. Material in this draft EIS supersedes both the FERC EIS and Elwha Report when there is a conflict in information.

Abstract: In addition to the proposed action, four other alternatives were examined. They are: Dam Retention with mitigation measures installed for fish passage, Removing Glines Canyon Dam only and installing fish passage measures at Elwha Dam, Removing Elwha Dam only and installing fish passage measures at Glines Canyon Dam and No Action (dams are retained without fish passage measures). Short term negative impacts from removing both dams could occur from sediment built up behind them. If sediment is allowed to erode naturally, the finer-grained particles, like silt and clay, could significantly impact fish or other aquatic organisms. Impacts on water quality, river morphology, long-term impacts on the native anadromous and resident (i.e. trout and char) fisheries, living marine resources, wildlife, threatened and endangered species, vegetation, cultural resources, land use, recreation, esthetics, socioeconomics and river ecology were also examined in the FERC document, Elwha Report and/or this draft EIS. Impacts from alternatives other than the proposed action may have significant impacts on each of these resources.

Comment period: The National Park Service (NPS) will accept written comments on this draft EIS for a period of 60 calendar days, starting from the notice of availability of this document.

Send comments to: Sarah Bransom, National Park Service, DSC-TWE-Planning, 12795 Alameda Parkway, Denver, Colorado 80225-0287, 303/969-2210.

For further information concerning Elwha River Ecosystem Restoration: call Brian Winter, Elwha Project Coordinator, at 206/452-0321.



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Summary





*Elinor Chittenden displays a steelhead caught in 1907, before the Elwha Dam was constructed.
(Asahel Curtis photo, Washington State Historical Society)*

*Previous page: Glines Canyon Dam construction, caption: "water overflowed -- workers rescued"
(Clallum County Historical Society)*

Summary

In the early 1900's, the free-flowing Elwha River on the Olympic Peninsula in Washington State was blocked with two hydroelectric dams. The Elwha Dam was built 4.9 miles from the mouth of the Elwha River in 1912, and impounded Lake Aldwell. Glines Canyon dam was built 8.5 miles further upstream in 1926 and created Lake Mills. The presence and operation of the dams causes several problems.

The dams block the migration path for several species of salmon and trout, which, after maturing in the ocean, return to the Elwha to lay their eggs (spawn). Migrating fish such as these are called anadromous. The dams also prevent the downstream flow of nutrients, sediment and woody debris the fish need to successfully spawn and rear juveniles. The Elwha River was used by 10 "runs" of salmon and trout before the dams were built. The fish fed more than 22 species of wildlife and were the basis of much of the culture and economy of the Lower Elwha S'Klallam Tribe. The flow regime of the river changed from meandering and braided in many places to less active and more channelized. Reduced sediment supply has caused the eastern edge of the pre-dam Elwha River delta to erode, the barrier beach at Freshwater Bay to recede and steepen, and has contributed to the erosion of Ediz Hook, the sandspit that protects Port Angeles Harbor.

In recognition of the problems, the Department of the Interior (DOI) finds, consistent with congressional intent expressed in Public Law (P.L.) 102-495 (see Appendix), there is a need to fully restore the native anadromous fisheries and Elwha River ecosystem. Because the wildlife habitat and Elwha River upstream of the dams is in a relatively undisturbed condition, fully restoring the 10 runs of salmon and trout would fully restore the Elwha River ecosystem. It would also return the cultural and economic focus of the Lower Elwha S'Klallam Tribe and promote the federal trust responsibility to affected Indian tribes.

The National Park Service (NPS) has taken the lead in preparing and summarizing environmental impact information in this document. In preparing this draft environmental impact statement (EIS), DOI has adopted the majority of a draft environmental impact statement titled "Proposed Elwha (Federal Energy Regulatory Commission (FERC) No. 2683) and Glines Canyon (FERC No. 588) Hydroelectric Projects, Washington" as updated and renamed Draft Staff Report in March 1993 prepared by the FERC. DOI has also incorporated the Elwha Report, prepared by the U.S. Departments of the Interior, Commerce and the Lower Elwha S'Klallam Tribe (Jan. 1994) and its appendixes, into the legal record for its EIS. Material in this draft EIS supersedes both the FERC EIS and Elwha Report when there is a conflict in information.

Chances for restoring 9 of the 10 runs of fish are rated as either good or excellent if both dams are removed.

This draft EIS examines several alternatives for restoring the fish habitat. Only one alternative has the potential to fully restore the 10 runs of salmon and trout -- the **Proposed Action** of removing both the Elwha and Glines Canyon Dams. Chances for restoring 9 of the 10 runs of fish are rated as either "good" or "excellent" if both dams are removed (sockeye salmon suffer from habitat problems outside the Elwha River basin and therefore have only "poor" to "fair" chances of returning to pre-dam numbers). Removing both dams would also restore natural flow conditions in the Elwha River.

Because federal agencies must examine a full range of reasonable alternatives, NPS also examined leaving the dams in place and installing passage facilities, as well as removing each dam separately. These alternatives are called: **Dam Retention** (with passage facilities installed at both dams), **Removal of Elwha Dam**, and **Removal of Glines Canyon Dam**. **No Action**, or leaving the dams in place without mitigation measures (as they are now), was also analyzed to provide a basis for comparing all action alternatives.

The chances of restoring native anadromous fish drop substantially under each of these alternatives. None of the 10 runs has a good or excellent chance of restoration if fish passage measures are installed or if Elwha Dam alone is removed. If Glines Canyon Dam is removed, there is a good chance steelhead runs (both winter and summer runs) would be restored. Chances of restoring the eight remaining runs would be lowered.

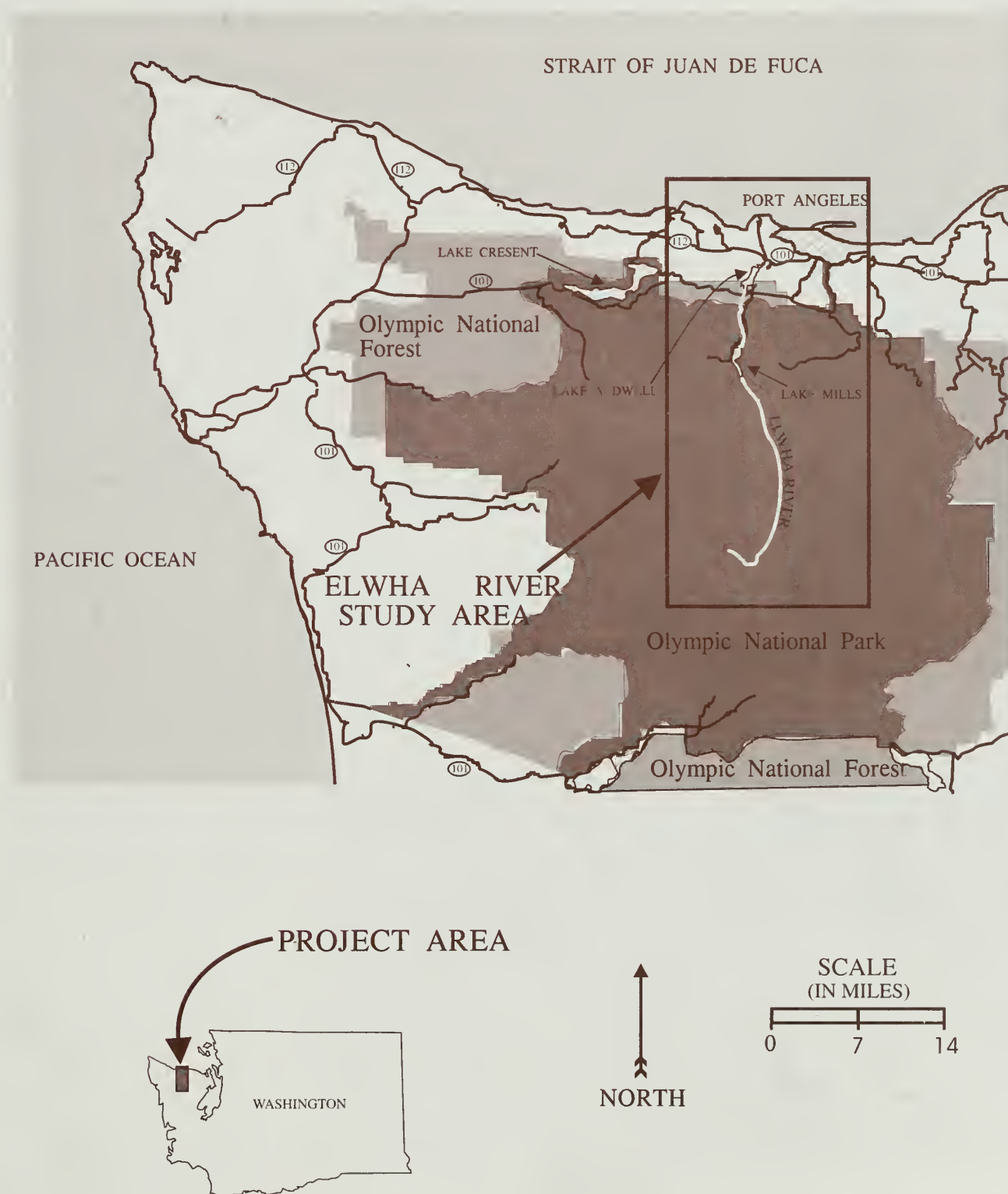
Other features of the Elwha River ecosystem would all benefit from the removal of the dams, including river morphology, nutrient transport, terrestrial wildlife, the marine ecology at the mouth of the river, vegetation, and threatened or endangered biota. Because animals need a year-round food source, the reintroduction of 10 runs of salmon and trout throughout the river's length would benefit wildlife in the area. Draining and revegetating the reservoir lands with native plants would provide additional habitat for wildlife. Threatened or endangered animals such as Stellar sea lions and bald eagles would benefit directly from an increase in available prey, and others from the creation of additional habitat. The river itself would return to its dynamic, free-flowing state, able to transport sand, gravel and nutrients all the way to the ocean. Water temperature which currently runs 2° to 4° C. higher in the middle and lower river than before the dams were built, would drop to normal levels.



There are some negative impacts which might occur from the **Proposed Action**. If the dams are removed, the sediment built up over the last 80 years might be released into the river, though it could be dredged and removed. If it is released uncontrolled, it could kill adult and juvenile fish, their eggs and other aquatic life. This is a temporary impact, but it could be severe in the short term.

As the dams are removed and upstream sediment flows into the middle and lower river, the riverbed itself may rise to pre-dam levels, 1 to 5 feet over the

Figure 1. Location Map.



present level. A raised riverbed would raise the water level also, and local flooding could occur more frequently.

Congress has directed DOI to protect downstream water quality for tribal, domestic and industrial users, and NPS will commit to that protection in the Record of Decision in this draft EIS.

Removing the dams would also have positive impacts on socioeconomic growth, renewed interest in cultural resources, recreation opportunities, and esthetics.

To give the secretary a broad range of feasible options, DOI will write a second EIS. If the secretary chooses **Dam Removal** as the best alternative, the second EIS will examine several ways to implement this decision. It will analyze the economic and environmental costs and benefits of each, and follow NEPA's public involvement requirements. This second EIS will hereafter be referred to as the "Implementation EIS" through this document.

The following discussion summarizes how each alternative compares in each impact area. This discussion is illustrated in chart form beginning on page 18 of this document.

Summary of Issues

Issues are defined as, "environmental problems which might occur if the **Proposed Action** or any of the alternatives are undertaken." The expected extent of these problems are called impacts. Impact analyses predict how severely a particular environmental resource (i.e. water quality) would be

affected if each of the alternatives are implemented. A description of issues follows, while impacts are discussed in the chapter entitled "Impacts of Each Alternative".



Olympic Power Plant - Lower Elwha River, 1911. (Daishowa/James River Company Photo)

Geology, River Morphology, Hydrology & Water Quality

The dams have limited coarse-grained sediment and woody debris from flowing downstream of river mile (RM) 13.4, the location of Glines Canyon Dam. As a result, cobbles, gravel, and sand have built up in deltas within each reservoir. This has denied salmon and trout the spawning gravel needed to successfully reproduce, and has contributed to the erosion of coastal features such as Ediz Hook and beaches near the mouth of the river.

There may be as much as 14 to 15 million cubic yards of fines, sand, gravel, and cobbles trapped within the two reservoirs, most of it behind Glines Canyon Dam. The Elwha Report investigates three ways to manage this sediment: 1) eroding the material to the Strait of Juan de Fuca, 2) mechanically removing the material to either a terrestrial or saltwater site, or 3) stabilizing the sediments within the confines of the existing reservoirs. These options or combinations of options would allow natural sediment transport to return to the middle and lower river. Alternatives for ecosystem restoration must consider potential effects of various sediment management options on fish and other aquatic life.

Under a scenario in which either or both dams are removed, coarser grained sand, gravel and cobbles released downstream would supply needed material to restore spawning sites in the middle and lower river. This material would settle and raise the riverbed to historic levels, as well as contribute to the rebuilding of the Elwha River estuary, nearshore beaches, and Ediz Hook. This erosion option would supply material to the river, but would also have a potentially adverse impact on spawning and rearing fish. The stabilization and removal options would not have these impacts, but restoration of the lower river in terms of sediment supply would take longer. Removing only Elwha Dam would allow the release of a relatively small amount of sediment (2 to 3 million cubic yards) into a relatively short section (4.9 miles) of river. This material would wash out to the Strait and not be replenished since Lake Mills would continue to trap upstream sediment.

Depending on the sediment management options selected, water quality could be adversely affected in the short-term. Water quality would also be degraded in the long-term if both dams are removed, since sediments would no longer be trapped in the reservoirs but naturally washed downstream. However, since elevated turbidity levels from the natural river would generally occur only during high flow periods, there would be little if any noticeable effect during low flow periods. The Elwha Restoration Act requires mitigation for water quality impacts.

In the long run, removal of both dams would positively affect native anadromous fish by returning spawning gravels throughout the lower and middle Elwha River, lowering water temperatures, and restoring fish habitats.



Elwha River, no date. (Clallam County Historical Society)

Native Anadromous and Resident Fisheries Resources

Currently there are no salmon or seagoing trout in either the middle or upper reaches of the river because of the dams. Installing fish passage facilities on existing dams would provide native anadromous fish access to unused habitat areas in the Elwha. At the same time, these passage measures may harm juveniles as they try to reach the sea, or adults as they move upriver. In addition, juvenile fish would continue to have problems negotiating the reservoirs, even with dam passage measures. Different levels of mortality due to passage for each species are expected under the different alternatives.

Fully restoring the fisheries would require suitable stock and restored habitat in the river or ocean. Stock suitability and fisheries pressure remain constant in each alternative, but habitat quality changes. In general, removing the Glines Canyon Dam results in better quality habitat than removing only the Elwha Dam. This is because the barrier to nutrients, debris and sediment from the entire upstream river is removed. However, these materials never enter the ocean and fish would need to navigate fish passage facilities at the Elwha Dam.

Living Marine Resources

Removing both dams would send sand, gravel and lesser amounts of cobble back into Freshwater Bay at the mouth of the river. As a result, the amount of sand-gravel type habitat should increase. This would change the present community from species which prefer rocky substrates (i.e. kelp, rock crabs,



fishing the Elwha in the 1920's. (Asahel Curtis photo, Washington State Historical Society)

clingfish, gunnels, barnacles and mussels) to those requiring a sandy substrate (i.e. eelgrass, Dungeness crab, flatfish and hardshell clams). It would also contribute to the restoration of the delta, estuary, and associated shellfish habitat. This would increase the shellfish fishery.

Wildlife and Vegetation

All action alternatives would reintroduce salmon and seagoing trout to the middle and upper Elwha River. Since many of these fish spawn and die, they provide a source of food for a variety of land-dwelling birds and mammals, and so may increase the populations of some of these species in the Elwha River Basin.



Removing either dam and draining and revegetating the reservoir lands would add terrestrial acreage. This would also eliminate wetlands which the reservoirs have created along the shoreline, and restore those along the river which existed before the dams were built. Species such as the trumpeter swan which presently use the reservoirs would lose their habitat, although this impact can be mitigated. Species such as the endangered marbled murrelet or bald eagle which depend on forest habitat and feed on salmon would benefit in the long run.

Land Use, Recreation and Esthetics

Land may be needed to dispose of dam and dredge material under any of the dam removal alternatives, although ocean disposal or other uses for the rubble will be explored in the Implementation EIS.

If either or both dams are removed, project land may be acquired. The Elwha Restoration Act prescribes land acquired inside the park be managed according to Olympic National Park policy. The Elwha Report studied whether land outside park boundaries was suitable for addition into the park, or would better be placed in the National Wildlife Refuge System, or held in trust for the Lower Elwha S'Klallam Tribe. The Act also requires river banks acquired in the project area outside the park be managed according to the tenets of the Wild and Scenic Rivers Act.

Hikers, campers, and anglers in the Elwha subdistrict of Olympic National Park would be temporarily kept out of the project area while construction of either fish passage or dam removal is underway. All dam removal alternatives require some fishing restrictions to restore the native anadromous salmon and trout to their historic ranges in the Elwha River, and would eventually improve fishing. These fish would compete with, and result in fewer resident trout, a condition consistent with a more natural system.

Whitewater rafters would be able to float additional sections of the river if either or both of the dams were removed. Boaters and anglers would lose the chance to use the reservoirs if the dams are removed.

Some hikers or campers might find the drawn-down reservoirs ugly because tree stumps and barren land would be evident for up to a few years following dam removal. Others might find fascination in the scene of a river returning to its natural state. In the long term, recreationists who seek a river experience would likely find the Elwha attractive if the dams are removed.

Socioeconomics

If both dams are removed, long term socioeconomic benefits from greater harvests of salmon and shellfish would accrue to commercial, recreational, and tribal fishermen. Presently, tribal residents are experiencing severe economic hardship; recovery of harvestable fishing stocks would benefit the tribe's economic base. And though reservoir recreation would be lost, river corridor recreation value would increase for salmon fishers and those seeking a wild and scenic river experience within Olympic National Park.

Removal of one dam, or retaining both dams with mitigation measures would partially restore some native anadromous fisheries and could result in limited gains to nature-based recreation.

Removal of both dams would improve shellfish abundance near the river mouth. Shell fish harvest is of high importance to the Lower Elwha S'Klallam Tribe.

Installing fish passage facilities would increase property tax payments to local government. Removing one or both dams would reduce or eliminate this tax revenue source, but would increase revenues to the local utility service from surcharges on delivery of regional power to the Daishowa Mill. As recreation and tourism related to river recovery increase, state and local tax revenues would also increase. This would be most pronounced if both dams are removed.

Removing one or both dams or installing mitigation measures would result in some direct employment, with the **Proposed Action** requiring the greatest number of personnel.

Cultural Resources

Cultural resources include structures, landscapes, traditional cultural properties, archeological sites, and contemporary resources such as fish and cedar used for cultural purposes. Ethnohistoric research indicates Elwha S'Klallam settlements were located along the Elwha River and coastal portions of the project area. Archeological research has demonstrated native occupation of the project area for centuries prior to the arrival of Euro-American settlers. Non-Indian settlement of the Elwha began in the 1860's when homesites were established far up the Elwha Valley. Homesteads were developed by both S'Klallam and Euro-American settlers.

Though the aboriginal S'Klallam harvested a variety of plants and animals, salmon were their most important source of food, both for immediate consumption and for seasonal storage. Restoring the salmon would restore an important traditional economic and social base for the tribe.

The tribe also has cultural properties which now lie under the projects or have been made inaccessible by them. Removing the dams could eventually uncover cultural resources inundated or buried by the projects, and reestablish blocked access.



In the late nineteenth and early twentieth centuries, the population along the Elwha made its living on local trading of produce and dairy products, lumber and shake mill work, packing, guiding, employment in Port Angeles and elsewhere, and provided much of the labor force to construct bridges and county roads in the vicinity. The development and construction of the dams was a major event in the valley during the early 20th century.

The historic resources of the area include structures at the Elwha Ranger Station Historic District, a bridge, and the hydroelectric projects themselves. Prior to removal, each dam would be fully inventoried, documented according to Historic American Engineering Record standards, and photographed. If both dams are removed, a wider meandering river and higher elevation riverbed might result and mitigation for potential flooding of the Elwha Ranger Station and other historic properties would need to be addressed.

Safety

Inspections by the Federal Energy Regulatory Commission and the U.S. Army Corps of Engineers have resulted in additional strengthening and securing of the two dams. The Washington State Department of Ecology Office of Dam Safety has indicated Glines Canyon Dam currently meets state safety standards for both probable maximum floods and earthquakes, and the Elwha Dam can withstand a probable maximum flood. It is unknown whether Elwha Dam could withstand earthquakes in the immediate vicinity.

If the dams were removed, the Elwha River would be resupplied with sand and gravel, and would return to its dynamic, free-flowing state. This means the river channel, which moves laterally much less than before the dams, would increase in elevation (aggrade) and meander over the entire floodplain. The existing levees on the outwash plain near the river's mouth might need to be raised and reinforced to provide the same level of flood protection or otherwise mitigated (e.g. flood insurance) to mitigate the increased possibility of flood.

Asbestos has been located in the power cables, residences and offices associated with the dams. polychlorinated biphenyls (PCBs) may be present in the transformer bushings or soil at the project sites, and samples collected in spring

of 1994 are currently being analyzed. Special handling and disposal of these materials would be required if the dams are removed.

Ecosystem and Stream Ecology

Before the dams were built, native anadromous salmon and trout entered, spawned and exited the Elwha River throughout the year. Removing both dams would reestablish this year-round supply of food to at least 22 species of birds and mammals. Vital nutrients released from decaying fish carcasses would also be restored. Removing only one dam, or installing fish passage measures on the existing dams would help reestablish some fish runs and hence improve the condition of the ecosystem and stream ecology, but to a lesser extent than the **Proposed Action**.

Tribal Trust

In addition to ecological damage, the projects have dramatically reduced the treaty fisheries of at least four federally recognized Indian tribes, including the Lower Elwha S'Klallam, the Port Gamble Klallam, the Jamestown Klallam and the Makah, and blocked access to treaty reserved usual and accustomed fishing places. This issue is discussed in various appropriate places throughout this document (water quality, fisheries, land use etc.). Impacts to the tribal trust are not discussed in a separate impact section in this document.

The tribes also have a federal reserved water right in the Elwha River in an amount necessary for the propagation of the treaty native anadromous fisheries and to meet the purposes of the Elwha S'Klallam Indian Reservation (see discussion of sediment, river morphology and water quality in this document). The two hydropower projects were built and operated for nearly 80 years with loss of tribal access to usual and accustomed fishing places, with significant loss of both freshwater and marine fisheries resources, and with no consideration for preservation of river hydrology or morphology relative to the needs of the fisheries.

These treaty reserved interests of the four Indian tribes to take fish as well as to access usual and accustomed fishing places are property interests subject to the federal trust responsibility which cannot be abrogated or diminished without the specific action of Congress.

In general terms, removing both the Elwha and Glines Canyon Dams would fully restore the Elwha River ecosystem and native fisheries, and promote the federal trust responsibility to affected Indian tribes. All other alternatives would partially restore the ecosystem and native fisheries in varying degrees, but would not promote the federal trust to affected tribes relative to the fisheries resource and access to usual and accustomed fishing places (letter from U.S. Bureau of Indian Affairs, Portland Area Director, August 26, 1994).

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*Elwha Canyon near Port Angeles, no date.
(Clallam County Historical Society)*

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Introduction





First Elwha Dam, no date. (Daishowa/James River Company Photo)

*Previous page: Site of present Elwha Dam prior to construction of bridge, circa 1895-1900.
(Daishowa/James River Company Photo)*

Introduction

In the early 1900's, the free-flowing Elwha River on the Olympic Peninsula in Washington State was dammed with two hydroelectric dams. Built without fish passage facilities, they blocked the upstream migration path for all of the species of native anadromous salmon and trout which had used the river for spawning. They also interrupted the downstream movement of gravel needed for spawning, and, through inundation, destroyed important river salmon and trout habitats.

By 1920, the dams supplied a portion of the power needs for a pulp and paper mill in Port Angeles, Washington. Currently the mill is owned by the Daishowa America Corporation. In 1968, the owner and operator of the dams (then Crown Zellerbach Corporation and now James River Paper) submitted an application to license the Elwha Dam and in 1975 an application to relicense the Glines Canyon Dam with the Federal Energy Regulatory Commission (FERC). Licensing was controversial and a number of parties challenged FERC's jurisdiction to relicense the Glines Canyon Dam primarily due to its location in Olympic National Park.

Before FERC could take action, it first had to comply with the National Environmental Policy Act (NEPA). In 1991, FERC published a draft environmental impact statement (EIS) and circulated it for public review. FERC received comments on the draft and responded to them by either changing the draft or answering directly in volume 2, "Responses to Comment." The modified draft and volume 2 would normally have been circulated as the final EIS prior to a licensing decision.

Congress responded to the controversy by enacting Public Law 102-495, the Elwha River Ecosystem and Fisheries Restoration Act (Act) in October, 1992. Under the Act, the secretary of the interior was directed to study ways to restore the native anadromous fisheries and ecosystem of the Elwha River. The Act stayed FERC's licensing process until the Congressional mandate could be completed. The Department of the Interior (DOI) requested the amended FERC EIS and Response to Comments be forwarded to DOI to help prepare the study. FERC complied, but renamed the two volumes "Draft Staff Report". These were never distributed to the general public.

In early 1994, the "Elwha Report" was reviewed by the public, finalized by DOI, and submitted to Congress. Congress called for the secretary of the interior to consider whether full restoration of the fisheries and ecosystem were possible only if both dams were removed, and if so, establish a "definite plan" for removal. The secretary determined that removing the dams was both feasible



and necessary to restore the fisheries and ecosystem and to promote the federal trust responsibility for affected Indian tribes. The Elwha Report examined several options for dam removal.

NEPA issues. While the Elwha Report reached certain conclusions about potential river restoration, further evaluation of issues, alternatives, and potential river impact is needed for the secretary of the interior to make a final decision. Such analysis is part of any NEPA documentation. A full range of alternatives to the proposed removal of both dams, and the environmental impact of each alternative must be analyzed. Much of this information and analysis presently exists in either the FERC draft EIS, Draft Staff Report or Elwha Report and appendixes.

FERC's reason for preparing an EIS was to determine whether to license the two dams. DOI's responsibility, as defined by the Act, is to support a decision on whether or not to remove the dams and fully restore the fisheries and ecosystem. Both agencies are bound by NEPA's requirement to be objective and study all reasonable alternatives, even those outside their jurisdiction. Therefore, although FERC licenses hydropower dams, its EIS examines the alternatives of removing each dam separately or removing both dams. Likewise, although the secretary of the interior is considering full restoration of the Elwha ecosystem and native fisheries, DOI will also examine single dam removal scenarios versus the installation of feasible fish passages on the existing dams. Thus the range of alternatives in both the FERC and DOI NEPA documents is substantially the same.

NEPA regulations encourage federal agencies to reduce paperwork and avoid repetitive impact analysis. Since much of the analysis required by NEPA has been performed by FERC, DOI has decided to adopt the FERC draft EIS, (amended March, 1993, Draft Staff Report) in preparing its own EIS (regulations 40CFR 1506.3). Also, since the Elwha Report postdates the FERC EIS, DOI incorporates it and its appendixes into the DOI EIS as well.

The complete DOI draft EIS is called the "Elwha River Ecosystem Restoration EIS," and consists of: the FERC draft EIS updated and renamed Draft Staff Report in March, 1993, and the Elwha Report and its appendixes, dated January, 1994. To facilitate the adoption of these four volumes, DOI has summarized relevant material in this document. This draft EIS not only summarizes material which has already been prepared and reviewed by the public, but cites sections and pages of the FERC EIS and Elwha Report where readers can find more information. This draft EIS also contains new information and analyses not found in either the FERC EIS or Elwha Report. Material in this draft EIS supersedes both the FERC EIS and Elwha Report when there is a conflict.

Public meetings on the DOI draft EIS will be held in Port Angeles and Seattle in late 1994, and comments on the package will be received through the winter.

This draft EIS focuses on impacts to those resources Congress has requested DOI to evaluate. By adopting the FERC EIS and incorporating the Elwha Report, DOI's EIS will provide the secretary with enough information to decide whether to remove the dams. Because the FERC EIS also details a single **Dam Removal** alternative, the secretary could decide to begin physical removal of a dam by implementing this single alternative, if he does not deviate from the FERC alternative and complies with the Act. Yet to be determined, however, are less expensive, lower impact dam removal alternatives. To give the secretary a broad range of feasible options, DOI will write a second EIS. If the secretary chooses dam removal as the best alternative, the second EIS will examine several ways to implement this decision. It will analyze the economic and environmental costs and benefits of each, and follow NEPA's public involvement requirements.



Elwha River - Island Camp, May 27, 1907. (Asahel Curtis photo, Washington State Historical Society)

This second EIS will hereafter be referred to as the "Implementation EIS" through this document.

For legal purposes, this draft EIS cites pages of the FERC EIS (updated March, 1993) which DOI will adopt to help the secretary make a decision. In this case, DOI will adopt all pages except: 2-8 to 2-16 (Applicant Proposal), 2-28 to 2-44 (Cost-Benefit Analysis), 3-109 to 3-110 (Impacts Associated with Replacement Power), 5-29 to 5-38 (FERC Staff Conclusions) and Appendix E (Cost Material). Any references to or summaries of these unadopted pages are considered stricken from the DOI EIS. DOI also incorporates the entire Elwha Report (January, 1994) and its appendixes into its EIS.

A limited number of copies of FERC's Draft Staff Report and volume 2, "Response to Comments" are available by calling the Denver Service Center of the National Park Service (Sarah Bransom at 303/969-2210). In addition, the FERC documents are also available at most public libraries and offices of the National Park Service in Seattle or Port Angeles. The Elwha Report is available by calling Olympic National Park, Elwha Project Coordinator, Dr. Brian Winter (206/452-0302).

Purpose and Need





Elwha River, no date. (Clallam County Historical Society)

Purpose and Need

Background

The 45-mile Elwha River and its 100-miles of tributaries were once rich in salmon and trout. These fish were used by Native Americans for thousands of years before the first European explorers reached the Northwest Coast. Today the Lower Elwha S'Klallam Indian Reservation, occupying 422 acres of land at the mouth of the river, is the homeland of the Elwha S'Klallam Tribe which bases much of its culture and economy on the salmon in the Elwha River. The salmon also provide substantial commercial and recreational catches in the ocean approaches to the river. The fisheries resources of the Elwha River are subject to the treaty reserved interests of four Indian tribes.

In 1913, the first of two dams was completed 4.9 miles from the mouth of the river. A second dam was built 8.5 miles further upstream in 1926 (see Figure 2). The Elwha Dam created a reservoir called Lake Aldwell and the Glines Canyon Dam created a reservoir named Lake Mills. Both dams were built without fish passage facilities.

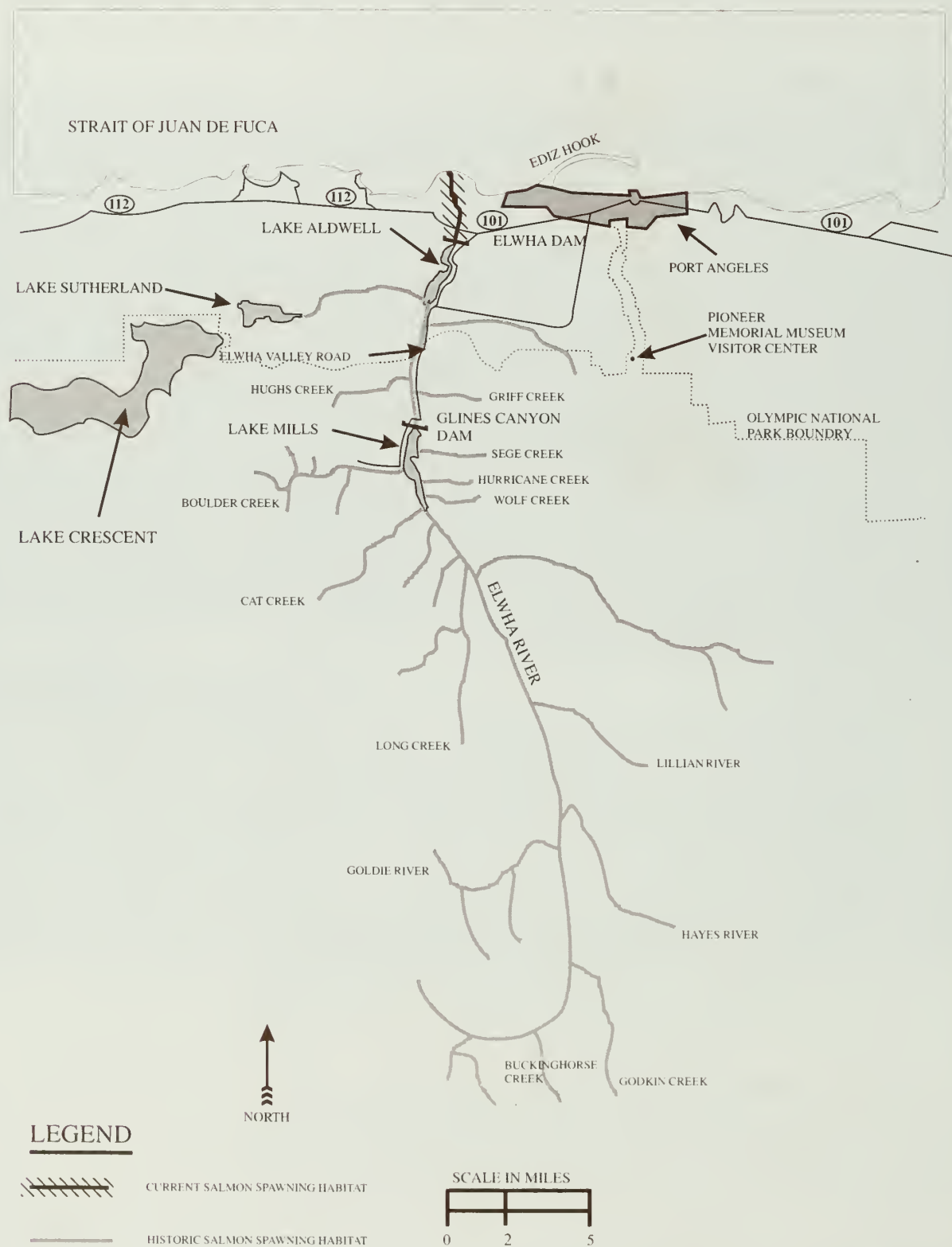
The number of native anadromous fish species have declined drastically since the dams were built. Although the fish have been subjected to pressure from the commercial marine fishing industry, the decline is primarily a result of the dams (Elwha Report, p. 3). While the fish can still swim up the first 4.9 miles of the Elwha, spawning gravel and woody debris essential to successful reproduction is held back by the dams. The dams have further degraded the downstream habitat by manipulating flows, making the river less active and "armoring" the riverbed, inundating important tributaries, and increasing stream temperatures by spilling warm surface water from the reservoirs in late summer and fall. High quality habitats exist upstream of the Glines Canyon Dam, but native anadromous fish cannot surmount either dam to access them.

In changing the river's flow characteristics from a meandering, braided channel to a channelized, more static system, the dams have affected the ecosystem dependent on the Elwha River. Wildlife which had previously fed on the salmon lost a year-round, stable supply of food. Because decaying salmon carcasses are an important source of nitrogen and phosphorus to the aquatic food chain, their absence has altered the entire river-based ecosystem.

In 1938, Congress established the Olympic National Park. In 1976, the park was designated as an International Biosphere Reserve and in 1981 gained the distinction of being named a World Heritage Site. In 1940, the boundary of the park was expanded to an area which included the Glines Canyon Hydroelectric

The fisheries resources of the Elwha River are subject to the treaty reserved interests of four Indian tribes.

Figure 2. Elwha River System and Watershed.



Project. The project is, however, inconsistent with National Park Service policy to "...restore natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species," (NPS Management Policies, 1988) for the reasons already stated. The project also conflicts with Olympic National Park objectives to "...conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization." (ONP Statement for Management, 1989). Both Lake Mills and Lake Aldwell have inundated sites of cultural and religious significance for the Lower Elwha S'Klallam Tribe and are inconsistent with the federal trust responsibility to the affected Indian tribes.

Unlike other dammed rivers in the northwest which are surrounded by development, the bulk of the Elwha River system is within the Olympic National Park and remains in a natural condition. The **Proposed Action** to remove both dams provides a rare opportunity to restore an entire ecosystem.

Purpose and Need

The Elwha and Glines Canyon Dams:

- block native anadromous fish passage to the majority of the Elwha River and tributaries;
- trap sediments and woody debris which provide critical fish habitat;
- limit nutrients important to the aquatic and terrestrial food chain of the Elwha River Valley;
- raise water temperatures, resulting in higher incidence of diseased or physiologically stressed fish;
- inundate important riverine and terrestrial habitat.

These impacts have resulted in a major decline in native anadromous fish stocks. Losses caused by these projects are inconsistent with the treaty rights of area tribes and the management objectives of federal and state agencies. Therefore DOI finds there is a need to return this river and the ecosystem to its natural, self-regulating state. The purpose of proposing action at this time is to fulfill the Congressional mandate to "...fully restore the Elwha River ecosystem and native anadromous fisheries..." consistent with the rights of Indian tribes secured by treaty or other federal law as stated in the Elwha Restoration Act (Public Law 102-495).

DOI proposes to remove both dams to accomplish this purpose. Congress has directed DOI to determine the feasibility of dam removal scenarios, protect downstream water quality for municipal and industrial users, and evaluate options for disposing of acquired lands outside park boundaries should the dams be removed. Specific alternatives for each can be found in the Elwha Report: for dam removal, pp. 65 to 90; for protecting water quality for municipal

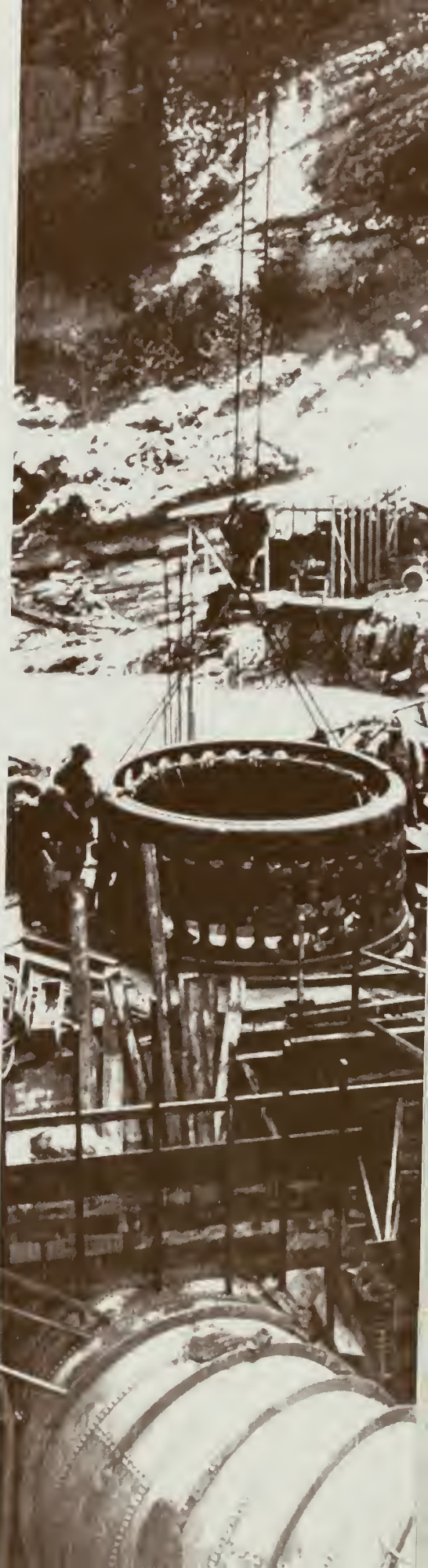
***DOI finds
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and industrial users, pp. 91 to 100; for disposal of lands pp. 117 to 120. All are considered technically feasible by DOI. Relative cost figures for dam removal and water quality protection for municipal and industrial users are presented in the Elwha Report. These issues, plus the treatment of specific associated dam structures, will be examined in more detail in the Implementation EIS.

*Glines Canyon Dam Construction,
no date. (Clallam County Historical
Society)*



*Description of the
Alternatives*





Starting of construction at the base of the Elwha Dam, circa 1910.
(Daishowa/James River Company Photo)

Previous page: Setting of generator on building base, 1921.
(Daishowa/James River Company Photo)

Description of the Alternatives

This chapter will describe each of the five alternatives DOI has analyzed in this draft environmental impact statement and summarize both the impacts of each and the degree to which each accomplishes the objectives set out in the chapter titled "Purpose and Need" of this document.

The Elwha Dam, built 4.9 miles from the mouth of the Elwha River, began operation in 1913. It is a concrete structure consisting of a central gravity-type section with an adjacent buttress-type intake section, flanked by spillways at each abutment. It is 450 feet long at its crest and 105 feet high. Lake Aldwell, the 2.5 mile impoundment created by the dam, has a total storage capacity of approximately 8,100 acre-feet. The total installed power generation capacity of the Elwha Dam is 14.8 megawatts (MW). The Elwha Dam was never licensed.

Glines Canyon Dam, located 8.5 miles further upstream, began operation in 1927. It is a varied radius, single arch concrete dam that is 210 feet high and varies in width from 55 feet at its base to 270 feet at its crest. The Lake Mills reservoir provides about 30,000 acre-feet of active storage, with drawdowns of up to 4,000 acre-feet during low flows. The total installed capacity is 16.0 MW. The Glines Canyon Dam has operated under an annual federal license since 1976.

Description of the Alternatives

Proposed Action

Removing both Elwha Dam and Glines Canyon Dam would require the acquisition and decommissioning of the two projects, draining the reservoirs, and removing all or part of the dams, powerhouses and auxiliary structures. As required by the Elwha River Ecosystem and Fisheries Restoration Act (P.L. 102-495), downstream municipal and industrial water supplies would be protected.

The specific steps to remove the projects are described in detail in the Elwha Report (pp. 70-90) and include: diverting the river around the dams to drain the reservoirs; decommissioning and removing all structures necessary for safety or for fish passage; and draining the reservoirs and managing the 14 to 15 million cubic yards of sediments which have accumulated behind the dams over the past 81 years. Several scenarios to manage sediment and divert the river have been investigated in the Elwha Report. The river could be routed by

way of a tunnel, surface diversion channel, low level diversion through the dam structure, or by notching the dam down from the top. Sediment could be transported naturally by the river, stabilized on site, or dredged and removed offsite. Pieces of the dams or historically important structures could be left in place.

Some of these options were investigated in the Elwha Report. Many of these options as well as other alternatives will be explored further in the Implementation EIS (see NEPA issues in the Introduction to this draft environmental impact statement). If the **Proposed Action** in this first EIS is selected by the secretary of the interior, the Implementation EIS will also address the specifics of fisheries and ecosystem restoration, protection of existing water supplies, flood control and disposition of acquired lands.

If DOI acquires the dams, an interim management scenario consistent with policy direction in the Elwha Restoration Act may be required while the Implementation EIS or other planning is underway. DOI may begin its native anadromous fisheries restoration efforts by planting some species in the middle and upper river while the dams are still in place. To accommodate juvenile downstream migration of these species, turbine runners may need to be removed at both dams.

At Glines Canyon Dam, water under high pressure flowing through the penstock and unimpeded by the turbine runners may require an energy dissipator. The dissipator would be located either within the powerhouse building itself or outside the riverbed on land already in a disturbed condition. A regulatory valve to help control flow through the penstock may be installed either directly in place of the turbine runner or in a steel pipe bypass physically connecting the penstock and energy dissipator. Such a bypass would be delivered to the site in sections and be located on already disturbed land outside the riverbed. Some construction vehicles would be required, such as a mobile crane, flatbed truck and/or cement mixer. These vehicles would use existing roads and the parking lot as a staging area. All standard practices to ensure fuel or leaks are contained would be followed.

At Elwha Dam, no energy dissipator or regulatory valve would be required, as flow can be controlled to a great extent by the use of spillways which exist on both the left and right abutments.

If turbine runners are removed, they may be cut up and sold for salvage value.

The environmental impacts of removing the turbine runners are expected to be minor, with some temporary impacts to air quality from the construction vehicle trips, and ground disturbance associated with the bypass around the Glines powerhouse. Oil or fuel used on site to construct the bypass or energy dissipator, should they be required, would be physically prevented from entering the river (through berms or other means).

Removing the turbines would also mean the loss of 18.7 MW, on average, of power the hydroelectric plants now produce. Costs of replacement power are analyzed in the socioeconomic section of this document, and the possible impacts of different sources of replacement power in the FERC EIS and Elwha Report.

No Action Alternative

Review of this alternative is required by the National Environmental Policy Act regulations. It provides an analysis of existing conditions against which to compare all action alternatives.

For the purposes of this EIS, **No Action** means that DOI would take “no action” and the two dams, powerhouses, reservoirs and auxiliary structures would continue to exist as they are now, without fish passage or other mitigation. DOI has used the **No Action** alternative described here because it is appropriate when compared to the range of actions DOI proposes to take.

Dam Retention Alternative

For the purposes of this draft EIS, DOI has assumed additional mitigation measures over and above those proposed by FERC. These measures are described in detail on pp. 29-31 of the Elwha Report, and are summarized here. This alternative is very similar to that described as “Applicant’s Proposal with Supplemental Measures” in the FERC EIS.

Elwha Dam would be fitted with a fish ladder, ladder entrance, holding and sorting pools and an inclined bar rack at the powerhouse tailrace exit portals to prevent fish attraction and entry into the draft tubes where the adult fish could be delayed or injured while migrating upstream. To pass juveniles downstream, all water would be passed through modified spillways and screens (either Eicher screens or traditional forebay screens) would be installed on intake structures. A bypass pipe and vertical traveling screen facility, an open channel flume and a concrete pool and weir structure would be built.



Penstock and powerhouse, no date. (Clallam County Historical Society)

Only by removing both the Elwha and Glines Canyon Dams would the Elwha River ecosystem and native anadromous fisheries be fully restored.

A trap-and-haul operation to convey fish past the 190-foot vertical lift at Glines Canyon Dam would be used to transport adults upstream. This system would include an electric weir to direct fish into the traps, holding and sorting pools, and a hoist system to load fish onto a transport truck as well as other features (see Elwha Report, p. 30). A year-round release of 450 cubic feet per second would flow over the Glines Canyon Dam spillway to help pass juveniles, and a screened or relocated intake for the powerplant would be installed. These last two passage features (450 cfs release and screened or relocated intake) are additional mitigation not described in the FERC EIS, but required by DOI.

In addition to fish protection, this alternative includes the enhancement of 898 acres of applicant (James River Paper) property outside Olympic National Park for wildlife benefits, and the construction of three remote boat-in campsites on the east side of Lake Aldwell.

Removal of Glines Canyon Dam Alternative

Glines Canyon Dam would be decommissioned, the reservoir drained and features of the dam, powerhouse and auxiliary structures necessary for safety or for fish passage removed. The mitigation measures described under the **Dam Retention** scenario for Elwha Dam would be installed. Sediment management and river diversion options, as well as land disposal, fish restoration and water quality mitigation measures for this alternative will be examined further in the Implementation EIS if the secretary chooses this option.

Removal of Elwha Dam Alternative

Features of the Elwha Dam project would be removed as necessary for safety or fish passage as described above, and the trap-and-haul and other mitigation measures for fish would be installed at Glines Canyon Dam.

Meeting DOI Objectives

In the “Purpose and Need” chapter of this draft EIS, the objectives DOI expects to accomplish by taking action are first introduced. In this chapter (“Description of the Alternatives”), each alternative is evaluated against these criteria to see how well it performs. DOI’s specific objectives are:

1. Fully restore all runs of Elwha River native anadromous fish.
2. Restore the Elwha River ecosystem.

In general terms, only by removing both the Elwha and Glines Canyon Dams would the Elwha River ecosystem and native anadromous fisheries be fully restored. Other action alternatives would partially restore the ecosystem and fisheries to varying degrees.

The following is a summary of how effectively each alternative meets the specific DOI objectives:

Objective #1. Fully Restore All Runs of Elwha River Native Anadromous Fish

Very few runs of native anadromous salmon and trout would be restored to the Elwha unless both dams are removed. Only winter and summer steelhead have a “good” chance for restoration in any of the partial restoration alternatives. All others have “fair”, “poor” or “no chance” of restoration. If both dams are retained without mitigation (i.e. **No Action**), self-sustaining runs of salmon would never be restored to the river.

This would particularly hurt the Lower Elwha S’Klallam Tribe, since many of its members are unemployed or economically depressed and depend on the fisheries for food and income.



Dam Retention

If mitigation as described in the “Alternatives” chapter of this draft EIS is added, three runs might be partially restored in the long term: coho, and the winter and summer steelhead. This partial restoration would include (as do all alternatives) phasing out hatchery production and enforcing severe fishing restrictions in the short term. As a result, although populations of wild coho and steelhead would be dispersed throughout the river’s length in greater numbers than exist today, the total number of native anadromous fish in the river would decline.

The seven other runs of salmon and trout have poor or unknown chances of restoration if both dams are retained and mitigated with fish passage measures because of passage losses, inundated riverine habitat, and poor habitat quality between and below the dams.

Removal of Glines Canyon Dam

If the Glines Canyon Dam is removed, chances of restoring steelhead, coho and Chinook rise over those in the **Dam Retention** alternative. Because these species are commercially valuable, this alternative would economically benefit the tribe, but to a far lesser degree than if both dams were removed. Removing this dam would recreate riverine habitat now inundated, reduce artificially high water temperatures, restore gravel, nutrients and organic debris needed in the middle stretch of the river, and remove Lake Mills, a serious barrier to juvenile outmigration for some species. Those fish unable to survive passage through Elwha Dam would fare poorly even if Glines Canyon Dam were to be removed. Pink and chum salmon fall into this category. Passage success for cutthroat and

native char is unknown. Lake Aldwell would continue to make river habitat unavailable for fish through inundation under this alternative.

Removal of Elwha Dam

Because the **Removal of Elwha Dam** still leaves Glines Canyon Dam in place, Chinook, coho and steelhead do not fare as well under this alternative as the **Glines Canyon Dam Removal** alternative. On the other hand, because passage over the mitigated Elwha Dam is unlikely for pink, chum and sockeye salmon, these species are expected to have a better chance for restoration under this alternative. The economic benefit to the tribe is expected to be about equal to the **Glines Canyon Dam Removal** scenario, but again, to a lesser degree than if both dams are removed.

If Elwha Dam is removed, Glines Canyon Dam would continue to block nutrients, spawning gravels and woody debris from the majority of the watershed. It would also present major passage problems for species who are unable to migrate through the still waters of the reservoir (many use the stream current to navigate), or withstand losses from the spillway or trap-and-haul process. Lake Mills would continue to inundate and replace riverine habitat under this alternative.

Proposed Action

Removing both dams would allow native anadromous fish to spawn upstream and allow nutrients, sediment and debris to flow unobstructed downstream into currently impoverished parts of the river. Chances for full restoration under this alternative are dependent only on the availability of suitable stock, and marine fishing pressure. A source of native Elwha River stock is available for most stocks and controls on fishing for several species of salmon are already in place to help protect and restore them to pre-dam populations along the northwest Pacific Coast. Options for using either descendants or neighboring populations to restore pink and sockeye salmon are considered feasible (Elwha Report, Appendix F).

With the exception of sockeye salmon, whose lake habitat in nearby Lake Sutherland is degraded and outside the project boundary, all species have a good to excellent chance of full restoration if both dams are removed. Sockeye stand a fair or poor chance of restoration.

The tribe would benefit both economically and culturally from the full return of the native anadromous fishery. It is estimated that this alternative would restore at least four times as many wild salmon and trout to the Elwha as the single dam removal alternatives.

Objective #2. Restore the Elwha River Ecosystem

An ecosystem is composed of physical and biological pieces which are mutually dependent upon or interactive with one another. Fully restoring an ecosystem means all are balanced, healthy, and functioning naturally.

In the case of the Elwha River basin, the role played by the 10 runs of salmon and trout, which occupied the river before the dams were built, is critical to ecosystem restoration. These fish brought nutrients from the sea, in the form of biomass or body weight, which they spread throughout the river as they migrated along its length. Their eggs and especially their carcasses supplied food to an abundance of birds and mammals throughout the river. Just as the fish carcasses supported the terrestrial wildlife, nutrients from decomposing carcasses were the base of an aquatic food cycle which eventually fed the juvenile salmon themselves.

As a result of competition for spawning sites, food and limited rearing habitats, salmon and trout evolved staggered timetables where adults of different species enter and spawn, and juveniles leave the river at different times of the year. This provided the terrestrial and aquatic ecosystems with a food and nutrient source throughout the year, even when other food was scarce.

No alternative except full **Dam Removal** would reestablish this pre-dam species distribution, or provide terrestrial and aquatic life with the nutrients they need to fully use other features of the natural habitat within Olympic National Park.

No Action

Native anadromous salmon and trout, and hence their biomass, never reach beyond the Elwha Dam or first 4.9 miles of the Elwha River. Birds and mammals which once depended on these fish for food are now limited only by the food that is available, and not by the quality of the rest of the habitat.

The river channel and flow characteristics are altered by the dams. Before the dams were built, much of the middle river (i.e. between the dams) was a meandering, braided channel with sand, gravel and cobble bars. The riverbed was composed of sand, gravel, cobbles and boulders, with most of the finer



Elwha Canyon near Port Angeles, no date. (Clallam County Historical Society)

grained material (silt and clay) washing through the system (FERC, p. 3-11). This sand and gravel would move during higher flows, preventing permanent vegetation from taking hold on in-river sediment bars.

Since the dams were built, the sand and gravel in both the lower and middle reaches of the rivers has become trapped in the reservoirs. Bedload is now composed primarily of cobbles and boulders which rarely move. The river meanders less and the channel has become more stabilized and less active. In some places, the channel has degraded (lowered) as much as 2 to 5 feet. In the absence of moving pulses of sand and gravel, "islands" of sediment have become vegetated, in some cases with mature trees.

***With both
dams
removed,
barriers
are
removed
for fish
migrating
upstream
and
nutrients
flowing
downstream.***

The estuary at the mouth of the river is also affected by the dams. It has decreased in size by about one-half mile from its pre-dam size, is deeper, and consists of larger cobbles and boulders. The estuary is used by all juvenile native anadromous fish during transition from freshwater to saltwater.

Dam Retention

Although mitigation measures would allow some fish to pass over the dams and swim upstream, the impacts to the ecosystem would largely remain. The flow of the river would remain unnaturally modified, sediments would not reach the middle or lower Elwha or the estuary at its mouth, and river and upland habitat would remain flooded by the reservoirs. Some fish would reach wildlife in the upper Elwha that use them for food, but far fewer fish would be available than under pre-dam conditions, and their migrations would be clustered into certain seasons rather than dispersed throughout the year.

Removal of Glines Canyon Dam

Glines Canyon Dam is located within the boundary of Olympic National Park (ONP). The impacts it causes are in direct conflict with the park's policy to "conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization", (ONP Statement for Management, 1989). The dam's removal would eliminate the obvious presence of modern civilization and restore natural ecological processes to the Elwha River valley to some extent within park boundaries. The river would, however, continue to be negatively affected by the remaining Elwha Dam, and because it presents passage problems for the native anadromous fish, wildlife and the aquatic ecosystem would be denied more than 500,000 pounds of fish biomass during critical times of the year (Elwha Report, p. 36). In addition, Lake Aldwell would continue to inundate important riverine and terrestrial habitat and affect water quality in the lower river by elevating water temperature during late summer and fall.

Stream flow regime and transport of nutrients, gravels and debris would resume, but only as far as Elwha Dam, where it would again be blocked until, in the very long term, Lake Aldwell filled with sediment and upstream material would be transported into the lower river. Even this would not result in natural, pre-dam conditions, however, as sediment stored in Lake Aldwell and its delta would remain permanently.

Although some fish would pass the Elwha Dam and be reintroduced into the middle and upper Elwha, species would not distribute themselves across the entire year and might not be available during critical wildlife feeding periods.

Removal of Elwha Dam

Because the Elwha Dam blocks sockeye migration into and out of Lake Sutherland, this alternative adds about 27,000 pounds biomass (Elwha Report, p. 36) to the projected total over and above that in the **Removal of Glines Canyon Dam** alternative. This contribution is negligible, however, in light of the fact that habitat in the middle river would remain in poor condition; temperatures would be higher than under natural conditions in the late summer and fall, and gravels for spawning would be absent. The water would also be lower in large organic debris and nutrients needed for rearing fish.

Stream flow characteristics would remain modified by the presence of Glines Canyon Dam, and species distribution of salmon and trout would still not approximate pre-dam conditions.

Proposed Action

Only this alternative would fully restore the Elwha River Valley ecosystem, because this alternative completely restores the natural biological and physical processes of the Elwha River. Removing the dams would restore important riverine and terrestrial habitat now inundated or made inaccessible by the reservoirs, and recreate a natural species distribution and abundance of native anadromous fish.

With both dams removed, barriers are removed for fish migrating upstream and nutrients flowing downstream. Approximately 800,000 pounds of fish biomass would return to the middle and upper Elwha River, and with it, 13,000 pounds of recycled nitrogen and phosphorus in the form of decaying carcasses (Elwha Report, p. 36). These nutrients would help support the aquatic food chain, and the fish themselves feed an abundance of wildlife. Because at least 9 of the 10 runs have a good or excellent chance of restoration, the river would be filled with salmon or trout throughout the year. This provides a necessary food source for some wildlife, especially during the critical late fall and winter months.



With no dams, the stream flow would return to its normal, dynamic state, naturally moving sand and gravel downstream, and flooding, changing course, undercutting riverbanks, and filling with coarse sediment as storms wash out material collected upstream.

The chart below summarizes impacts of each alternative so that readers may evaluate their comparative merits. The information in this chart was taken from the chapter in this document titled "Impacts of Each Alternative."

Table 1. *Impact Summary Chart*

	ALTERNATIVES				
	No Action	Dam Retention	Glides Dam Removal	Elwha Dam Removal	Proposed Action
FLUVIAL PROCESSES					
flow regime	static	static	middle section somewhat dynamic	static	dynamic
aggradation	none	none	1-2 ft. between reservoirs	temporary	1-5 ft., (pre-project conditions)
sediment & organic matter transport	limited	limited	restored to middle river	partially restored below Elwha Dam	fully restored
Ediz Hook	erodes at present rate	erodes at present rate	erodes at present rate	erodes at present rate	restored in long term
WATER QUALITY					
turbidity: long term	periodically turbid	periodically turbid	periodically turbid	periodically turbid	periodically turbid
turbidity: short term	no change	some additional during construction of fish passage measures	could be more turbid, depends on sediment mgmt. scenario	some additional turbidity in lower river	could be more turbid, depends on sediment mgmt. scenario
temperature	elevated during summer	elevated during summer	near normal	elevated	normal

Table 1. Impact Summary Chart (continued).

	ALTERNATIVES				
	No Action	Dam Retention	Glines Dam Removal	Elwha Dam Removal	Proposed Action
FISHERY					
Restoration potential					
pink salmon	none	none/poor	none/poor	poor	good
chum	none	none/poor	none/poor	poor	good
searun cutthroat	none	unknown/poor	unknown	unknown	good
native char	none	unknown/poor	unknown	unknown	good
summer/fall Chinook	none	poor	fair/good	poor/fair	excellent
spring Chinook	none	poor	fair/good	poor/fair	good
coho	none	fair	fair/good	fair	good/excellent
summer steelhead	none	fair	good	fair	excellent
winter steelhead	none	fair	good	fair	excellent
sockeye	none	none/poor	none/poor	poor/fair	poor/fair
Spawning habitat gravels					
	river habitat inundated, devoid of spawning gravels in mid and lower river	river habitat inundated, devoid of spawning gravels in mid and lower river	river habitat inundated, devoid of spawning gravels below Elwha Dam	river habitat inundated, devoid of spawning gravels in middle river	river habitat restored, spawning gravels restored to mid and lower river
Impacts to resident trout population					
	none	reduce population	reduce population	reduce population	reduce population
LIVING MARINE RESOURCES					
marine community	favors organisms that prefer offshore rocky substrate	favors organisms that prefer offshore rocky substrate	favors organisms that prefer offshore rocky substrate	favors organisms that prefer offshore rocky substrate	sandy substrate restored, favors organisms that prefer sandier substrate, hardshell clams may be restored to area

Table 1. *Impact Summary Chart (continued).*

	ALTERNATIVES				
	No Action	Dam Retention	Glines Dam Removal	Elwha Dam Removal	Proposed Action
WILDLIFE AND VEGETATION					
Restoration potential					
terrestrial wildlife - prey and habitat	habitat underutilized, 715 acres habitat inundated	habitat underutilized, 715 acres habitat inundated	habitat more fully utilized, prey partially restored, 290 acres habitat inundated	habitat underutilized, prey partially restored, 425 acres habitat inundated	habitat fully utilized, prey fully restored, 715 acres habitat restored
threatened and endangered species - prey and habitat	habitat inundated, prey lost	habitat inundated, prey lost	some prey, habitat partially restored	some prey, habitat partially restored	prey return, habitat fully restored
vegetation restored	no change, 715 acres inundated	no change, 715 acres inundated	425 acres recovered	290 acres recovered	715 acres recovered
restored wetlands	none	none	26 acres new, 4.7 acres lost	22 acres new, 38 acres lost	48 acres new, 122 acres restored, 43 acres lost
LAND USE, RECREATION, ESTHETICS					
Land Use					
Olympic National Park	conflicts with park policy	conflicts with park policy	somewhat inconsistent with park policy	conflicts with park policy	conflicts with park policy
National Marine Fisheries Management Plan	inconsistent with plan	largely inconsistent with plan	somewhat inconsistent with plan	largely inconsistent with plan	fully consistent with plan
Clallam County Comprehensive Plan	inconsistent	largely inconsistent with plan	somewhat inconsistent with plan	largely inconsistent with plan	fully consistent with plan
Esthetics					
views	lake views	lake views	river and lake view	river and lake view	river view
park recreation	reservoir oriented	reservoir oriented	river oriented	reservoir oriented	river oriented
fishing	river trout & reservoir fish, limited salmon	river trout & reservoir fish decrease, some salmon	salmon & trout increase, fewer resident trout	salmon & trout increase, fewer resident trout	full restoration of native salmon & trout, resident trout decrease

Table 1. Impact Summary Chart (continued).

ALTERNATIVES

	No Action	Dam Retention	Glines Dam Removal	Elwha Dam Removal	Proposed Action
CULTURAL					
tribal	tribal river focus lost	tribal river focus lost	tribal river focus lost	tribal river focus lost	tribal river focus restored
cultural properties	inundated and inaccessible	inundated and inaccessible	some inaccessible	some uncovered and accessible	all uncovered and accessible
historic structures	dams in place and on National Register of Historic Places	dams modified and potentially ineligible for National Register of Historic Places	one dam removed and the other potentially ineligible for National Register of Historic Places	one dam removed and the other potentially ineligible for National Register of Historic Places	both dams removed but fully inventoried. Potential loss of historic structures
SOCIOECONOMIC					
property taxes	\$231,000 (1994)	large increase	small increase	moderate decrease	none
construction jobs	0 (now)	32 person years	172 person years	84 person years	228 - 1,542* person years
operations jobs	10 (now)	14 person years	7 person years	7 person years	1 person year
tribal fishery restoration potential	no restoration	poor or fair for most runs	poor to good for most runs	poor or fair for most runs	9 or 10 runs good or excellent for most runs
FERC cost estimates	\$0	\$17M - \$34M	\$66M - \$72M	\$44M - \$50M	\$76M
Base year (1997) local real cost replacement power (millions of dollars)*	\$2.1	\$6.2	\$5.6	\$8.4	\$4.8

* Estimates differ from FERC analysis and are taken from P. Meyer, "Discussion and Extended Analysis of Energy Portions of the FERC Draft Staff Report on Glines Canyon and Elwha Hydroelectric Projects, Washington." August 15, 1994. Construction jobs under proposed action include direct and indirect employment.

Table 1. *Impact Summary Chart (continued).*

	ALTERNATIVES				
	No Action	Dam Retention	Glines Dam Removal	Elwha Dam Removal	Proposed Action
SAFETY					
ability to withstand maximum probable flood	safe	safe	precautions needed during dam removal	precautions needed during dam removal	precautions needed during dam removal
earthquake	Glines safe, Elwha unknown	Glines safe, Elwha unknown	Elwha unknown	Glines safe	N/A
localized floods	occur now	same frequency and impact as now	may be more frequent	may be slightly more frequent	may be more frequent
ECOSYSTEM					
biomass (1,000 lbs. of salmon/trout)	0	109	284	312	818
nitrogen & phosphorous (pounds)	0	1,800	4,770	5,200	13,000
number of runs with "good" or better restoration potential	0	0	2 to 5	0	0
river ecology	nutrients & debris blocked, flow regime altered	nutrients & debris blocked, flow regime altered	nutrients & debris blocked to RM 4.9, flow regime natural to RM 4.9	nutrients & debris blocked, flow regime altered	nutrients & debris transported along entire river, flow regime restored

*Impacts of Each
Alternative*





Elwha River, no date. (Clallam County Historical Society)

*Previous page: Starting of construction at the base of the Elwha Dam, circa 1910.
(Daishowa/James River Company Photo)*

Impacts of Each Alternative

This chapter will first present a description of existing environmental conditions for each resource (i.e. sediment, water quality, etc.), and then a discussion of impacts expected to the resource if the alternatives were to be implemented. The existing conditions are termed "Affected Environment."

Sediment, River Morphology and Water Quality

Affected Environment

The Elwha River is 45 miles long, has 100 miles of tributary streams and drains 321 square miles of the Olympic Peninsula. Eighty three percent of the drainage lies within Olympic National Park and comprises about 20 percent of the total park area. Impoundment of the river in Lake Mills and Lake Aldwell have inundated 5.3 miles of riverine and 715 acres of lowland habitat.

Annual precipitation in the Elwha River basin ranges from 220 inches in its upper reaches to 56 inches near the mouth of the river. Average discharge is 1500 cubic feet per second (cfs) (U.S. Army Corps of Engineers, personal communication, August 1994). Discharge is influenced by early winter storms, spring snowmelt and baseflow conditions during the summer. The lowest flow period is during late summer.

The upper portion of the Elwha River has a steep gradient (16 percent) and is bounded by steep canyon walls or a narrow floodplain. Downstream, the river has a gentler slope and is surrounded by a broad floodplain.

The Elwha River, its tributaries, Lake Mills and Lake Aldwell are classified by Washington Department of Ecology as Class AA waters, signifying waters having "extraordinary" water quality. Overall, the Elwha River has relatively low concentrations of dissolved and suspended sediment loads, nutrients and organics. Changes in natural water quality occur in the lower part of the watershed, and are mostly a result of reduced sediment load and elevated water temperatures during the summer. Suspended sediment concentrations and turbidity of the lower river are related to flood flows, logging, agricultural practices and bank erosion.

The Elwha River, its tributaries, Lake Mills and Lake Aldwell are classified by Washington Department of Ecology as Class AA waters, signifying waters having "extraordinary" water quality.

The city of Port Angeles holds 200 cfs of the 206 cfs water rights issued by the state on the Elwha River. The city has a 50 cfs groundwater right for municipal purposes at a Ranney well next to the river. It has a 150 cfs surface right covering a diversion structure and canal about 3 miles upstream from the river mouth. This surface diversion provides water to industrial users, including two large paper and pulp mills. It also provides water to the Washington Department of Fisheries and Wildlife (WDFW) fish rearing channel. Private landowners and the Lower Elwha S'Klallam Tribe hold rights to the other 6 cfs. In trust for the tribe, the United States holds additional water rights which are not issued by or registered with the state. These rights protect sufficient water to support treaty fisheries and the purposes of the Lower Elwha Indian Reservation.

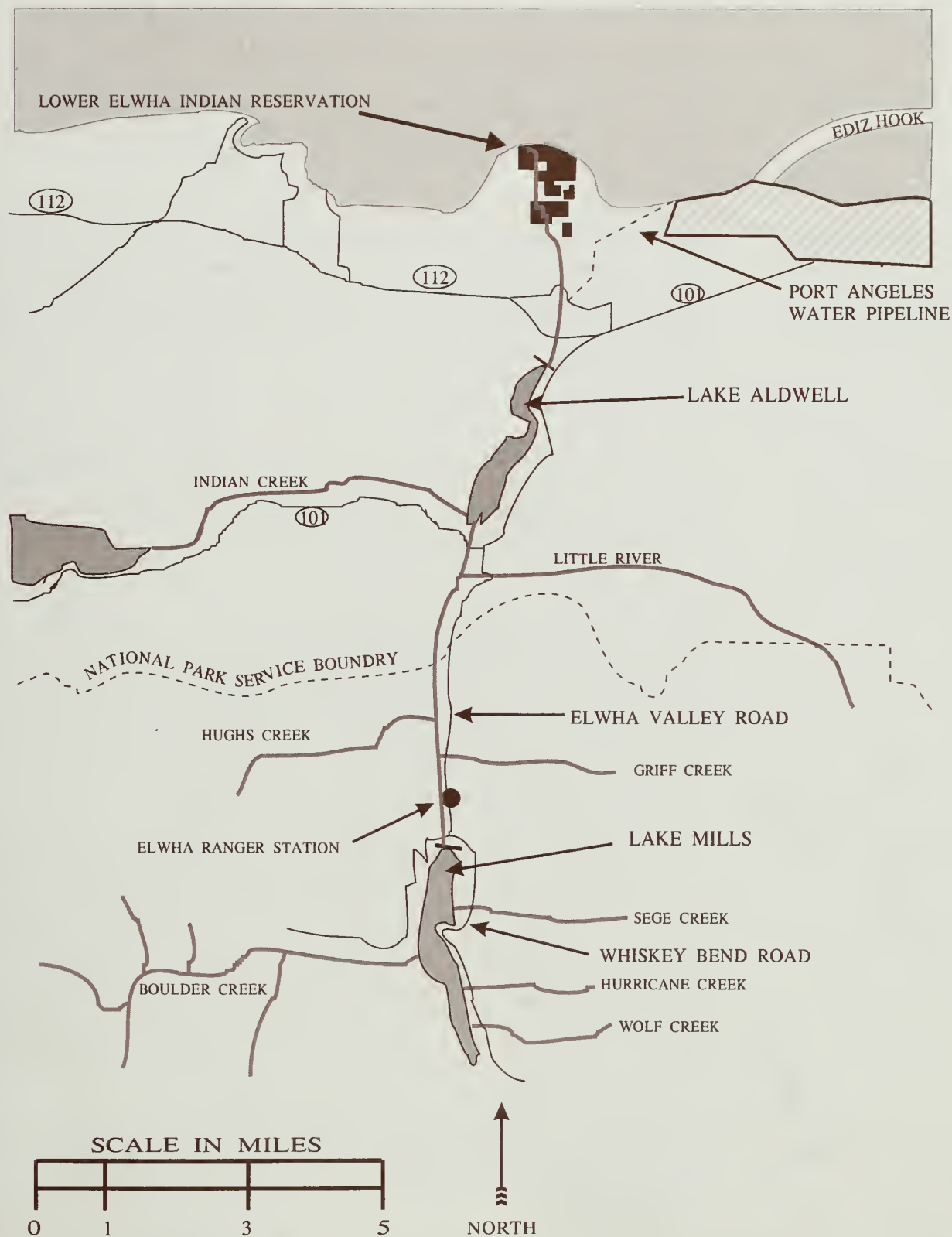
Surface deposits in the Elwha River drainage basin are dominated by glacial deposits and recent alluvium. Fine-grained silts and clays developed in the last 8,000 years as glacial deposits provide much of the material transported by the Elwha River.

Near what is now Lake Mills, the pre-dam river gradient was less steep than immediately up or downstream. In this natural "bottom" or flatter area, the Elwha River was a meandering and locally braided channel with gravel and cobble bars. These bars were maintained with high sediment input from upstream and from erosion of the surrounding floodplain and valley walls. Sand and gravel are currently trapped in Lake Mills and the riverbed in the middle stretch has become "armored" with only larger cobbles and boulders remaining. Without sand and gravel, local channel migration has decreased and tributaries have become well-vegetated in many cases. Similar conditions exist in the two miles below Elwha Dam.

Below this point, the river flows out into a wide, wooded floodplain whose soils are sands, silts and cobbles of glacial origin. It is bound on the west side by steep cliffs over 150 feet high. The pre-dam river channel was able to migrate throughout its entire floodplain, measured as 1.2 miles across near the mouth of the river. This prevented the establishment of woody vegetation. Currently, channel migration near the mouth of the Elwha River is constrained by dense, woody vegetation in the floodplain and on the east by a setback levee constructed in 1989. This levee is located beyond the limits of the current meander-belt width (based on empirical relationships and historical evidence from aerial photographs). However, it is not considered structurally capable of constraining channel migration if that meander-belt is widened, as it may be if the dams are removed (U.S. Army Corps of Engineers, 1994). A levee on the west side of the river near its mouth also restricts channel migration. It may be necessary to modify these levees if the dams are removed.

Over the past 5,000 years an extensive delta has formed at the mouth of the Elwha River. Through littoral drift, the river also brought enough sediment to form nearby Ediz Hook, an above-surface extension of sand, gravel and cobbles

Figure 3. Generalized Land Uses in Project Vicinity.



which forms the bayward side of Port Angeles Harbor (FERC p. 3-20). Before the Elwha Dam was built in 1914, discharge to the Elwha River delta was about 280,000 cubic yards per year (FERC, p. 3-19). Currently the only source of sediment for the Elwha delta is reworking of alluvium and the erosion of gravel from bluffs along the river. As a result, present day sediment yield from the lower Elwha is about 2 percent of the pre-dam figure, or 5,900 cubic yards per year, and the eastern edge of the historic Elwha River delta has eroded substantially (75 to 150 feet of shore recession; FERC, p. 3-19)

The western shore of Ediz Hook has also eroded, in part because river sediment has been reduced. However, sediment in Freshwater Bay east of the river mouth was at one time supplemented by erosion from marine cliffs which lie along the coast. These cliffs eroded laterally at a rate of up to 4 to 5 feet per year, providing as much as 290,000 cubic yards of material in a single year. In the early 1930's, a water supply line from the Elwha to Port Angeles was routed at the base of these bluffs. To protect the pipeline, the bluffs were armored, and lateral erosion dropped to one foot per year.

In the 1960's, additional erosion protection for the bluffs dropped sediment loads even further, to an estimated 40,000 cubic yards per year. These erosion control efforts substantially contributed to the lack of sediment and subsequent erosion of Ediz Hook and beaches in the area (FERC, p. 3-19).

Impacts

The dams and reservoirs have altered and continue to alter the character of the river, and their impacts are the impacts of the **No Action** alternative. The morphology of the Elwha River has been modified by the presence of Lake Mills and Lake Aldwell. Dam construction has resulted in trapping sediment, large woody debris and nutrients in the reservoirs, and altering water quality and aquatic habitats downstream from the dams, including inundation of native anadromous fish habitats.

Although a portion of the fine material (clays and silts) has escaped the dams and been transported to sea, the primary source of larger sediment for the lower and middle river has been landslides and local erosion of the river banks. This means there is much less sand and gravel in these reaches than before the dams were built. As a result, the riverbed may be as much as 1 to 5 feet lower than under pre-dam conditions (FERC, p. 4-2), and is composed primarily of cobbles and boulders which move only during very high flood events (greater than 9,000 cfs, FERC, p. 4-184). Armoring has left some sediment in place long enough that shrubs and even trees have grown on sand and gravel bars. (Elwha Report p. 11, FERC pp. 3-5 to 3-20).

As of 1989, the volume of reservoir sediment in Lake Mills was estimated to be 11.3 million cubic yards. If averaged over the years since Glines Canyon Dam was completed (1926 to 1989), this would mean about 180,000 cubic yards per

year has been trapped in the reservoir. It is unlikely this kind of uniform transport of material has been the annual norm, since there is evidence of upstream landslides during this same period.

All of the coarser grained gravel, sand, cobbles and boulders, and a portion of the finer clays and silt have settled in the reservoirs. In Lake Mills, silt and clay deposits are as deep as 12 feet. A delta at the upper end of Lake Mills consists primarily of sand and gravel (with smaller amounts of clay, silt and boulders), and is as much as 70 feet thick (FERC, p. 3-11).

The FERC Draft Staff Report estimates the volume of sediment in Lake Aldwell to be 4 million cubic yards, and the Elwha Report, between 2.6 and 4 million cubic yards (Elwha Report, p. 11; FERC, p. 3-14). Approximately one-half of these deposits were trapped in the reservoir prior to construction of the Glines Canyon Dam.

No Action has also exerted an affect on the nearshore marine environment. Deposits in the intertidal and shallow subtidal zones are primarily cobbles instead of sand.

In the summer months, water temperatures are elevated in the reservoirs due to their relatively large surface area and long residence time. Releases of water from Lake Mills in the late summer (August and September) raises downstream water temperatures up to 4° C (FERC, p. 3-24). Warmer temperatures in the middle and lower portions of the Elwha River have been linked to the occurrence of *Dermocystidium salmonis*, a disease which has caused increased mortality in the lower Elwha population of Chinook salmon. With the exception of these increases in temperature during the summer and increased turbidity during periods of high flow, there is little overall variability in water quality in the Elwha River.

The reservoirs dampen the impacts of minor or short-duration flooding, but are not used to attenuate most floods partially because of limited storage capacity. Water has also been released from the reservoirs during critical low flow periods to maintain river flows.

Although some additional sediment would be introduced into the middle and lower Elwha River during construction of fish passage measures, the long-term impacts of the **Dam Retention** (with mitigation) on sediment transport and water quality would be identical to those described above for the **No Action** alternative.

The amount of sediment introduced into the river in the short term, with impacts on both the coastal zone and downstream water quality, vary according to the dam removal alternatives. (The feasibility of several of these alternatives was examined as required by Public Law 102-495 in the Elwha Report. The Elwha

Reduced sediment supply has caused the eastern edge of the pre-dam Elwha River delta to erode, the barrier beach at Freshwater Bay to recede and steepen, and has contributed to the erosion of Ediz Hook.

Report also fulfilled the secretary of the interior's obligation to examine options to protect downstream municipal and industrial water quality, should the dams be removed. Some of these options are presented at the end of this section under "Mitigation Measures.") For the purposes of this document, DOI has assumed a spectrum of sediment input scenarios if the dams are removed. The Elwha Report estimates that allowing all sediment behind the dams to wash out naturally would result in the highest amount of sediment in the river in the short term. It, along with stabilization of sediments in place, is among the low cost options (see Elwha Report, pp. 140-141). Mechanically removing sediment or stabilizing it on site before the dams are removed would be the most costly (see Elwha Report, pp. 138-139) but potentially result in the lowest amount of sediment entering the river in the short term. Combinations of these approaches are possible and some will be analyzed in the Implementation EIS.

With **Removal of Glines Canyon Dam**, the natural sediment supply would return to the middle reach of the river and settle in Lake Aldwell. Suspended sediment concentrations would approximate those encountered in glacial rivers in the region. Over the long-term, normal sediment loads would reach the middle part of the river and could result in a one to five foot higher riverbed elevation and increased flood levels of one to two feet. As sediment continues



Elwha River, no date. (Clallam County Historical Society)

downstream to Lake Aldwell, the amount of suspended sediment passing through Elwha Dam would substantially increase. Lake Aldwell would fill completely with sediment, the project (Elwha Dam) would lose its hydroelectric value and sediment would flow into the lower river.

Under the **Removal of Elwha Dam** alternative, 2.6 to 4 million cubic yards of sediment would be expected to wash into the lower river and coastal zone. Coastal erosion would still continue to occur, however, due to reduced sediment supply. Lake Mills would continue to trap the upstream sediments, and within 260 years would be filled completely (Elwha Report, p. 49).

If both dams are removed, up to 14 to 15 million cubic yards could eventually be introduced into the river system if the river were allowed to erode reservoir sediment naturally. Sediments could also be stabilized with rip rap, vegetation or other means on site, or mechanically removed and deposited on land or in the ocean. The dams could both be removed in the same year, or their removal could be sequenced over several years.

If the sediments are not stabilized but washed out naturally, and both dams removed in one or two years, water could become turbid enough to kill large numbers of fish, their eggs, and other aquatic life. If dam removal is sequenced over several years, fish could experience periodic lethal or harmful doses of silt and clay over as many as four to ten years. Mechanical removal of fine-grained sediment or complete stabilization of sediments on site before the dams are removed would reduce or eliminate fish kills. Either or both of these options may be more fully examined in the Implementation EIS.

Alternatives which remove both dams would return near natural sediment transport conditions (a city diversion structure near the mouth of the river may remain). This would help restore Ediz Hook, the Elwha River delta and the beach at Freshwater Bay. Presently these features are eroding in whole or part because they have been denied normal sediment flow from the Elwha since 1912.

Following removal of both dams and revegetation of the reservoir area, channel activities and substrate conditions would eventually return to near pre-project conditions (see "Affected Environment"). Research has shown river systems generally recover from extreme sediment events within two to seven years of the time of reduced sediment supply (FERC, p. 4-92).

Increased sediment to the coastal areas would create shoals and bars, and supply sediment to the river delta, Angeles Point, and Ediz Hook. In the long-term, some of these features would be partially or fully restored (FERC, p. 4-93).

Aggradation, or the degree to which the riverbed rises, differs with each alternative. **No Action** or **Dam Retention** (with mitigation) would continue to

Lake Aldwell would fill completely with sediment, the project (Elwha Dam) would lose its hydroelectric value and sediment would flow into the lower river.

deny sediment to the middle and lower river. This has resulted in a one to five foot drop or degradation of the riverbed in some places. If either **Removal of Glines Canyon Dam** or the **Proposed Action** is selected, and the sediments stored in Lake Mills are allowed to erode naturally, an estimated 11.3 million cubic yards would be released into the river and upstream sediment transport would be restored. This could raise the riverbed one to five feet in some places, and cause more frequent localized flooding. If only Glines Canyon Dam is removed, sediment would settle in and soon fill Lake Adwell. If both dams are removed, the sediment would be transported into the lower river and could aggrade pieces of this reach of the riverbed as well. Downstream levees may need to be raised as much as four feet and strengthened with rip rap to withstand the increased flooding (Elwha Report, pp. 36-37) **Removing just Elwha Dam** and allowing sediment to erode naturally would send between 2.6 and 4 million cubic yards into the lower river and Freshwater Bay. Because natural sediment transport would not be restored, this sediment is likely to eventually wash out of the lower river and return it to its present, degraded condition.

Removing either Glines Canyon Dam or both dams would reduce downstream water temperatures up to 4° C in the late summer and early fall. Short term increases in organic matter, bacteria and nutrients would occur in the middle and lower reaches of the Elwha River (FERC, p. 4-96). This could cause periodic lethal or harmful decreases in dissolved oxygen for aquatic life in the river. Over the long term (two to ten years, depending on the sediment management and the dam removal scenario chosen), the introduction of more organic matter into the Elwha River would increase aquatic invertebrate diversity and productivity of the river below the dams.



Impacts to existing water users could result from the Elwha River channel migrating laterally across the floodplain, and from sediment input. For those users who draw on surface water (industrial users and fish hatcheries), sediment could directly affect their operation (FERC, p. 4-97). Water is currently treated before it is used by Rayonier and Daishowa mills because the river is turbid under high flow conditions. The Washington Department of Fish and Wildlife (WDFW) rearing channel is fed directly from surface flow, although the Tribe's hatchery is supplied with an underground infiltration gallery. The city of Port Angeles' domestic water is filtered by underground gravels and sands before it reaches the Ranney collector, and is expected to be only slightly affected (FERC, p. 4-97), although the state Department of Health is currently evaluating whether the city's supply could be contaminated through surface water sources of organisms such as *Giardia lamblia*, *Legionella*, or viruses (Washington Dept. of Health, letter to U.S. Bureau of Reclamation, 1994).

Mitigation

Mitigation for impacts on municipal and industrial water users from removing the dams is required by the Elwha River Ecosystem and Fisheries Restoration Act, Public Law 102-495. It mandates protection of "...existing quality and availability of water from the Elwha River for municipal and industrial use from possible adverse impacts of dam removal," and goes on to say the costs to design, construct, operate and maintain these water quality control facilities "...shall be borne by the secretary of the interior." Initial cost estimates for the described mitigation measures are presented in the Elwha Report (p. 99), but mitigation measures will not be selected until the Implementation EIS is finalized. The following mitigation measures are technically feasible and, if implemented, would fulfill the congressional directive. They are analyzed in the FERC EIS (pp. 4-102 to 4-104) and the Elwha Report (pp. 98 to 100).

If necessary, the city of Port Angeles municipal water supply could be protected through the construction and use of additional Ranney wells. Periodic back-flushing of the Ranney well collectors might be necessary to prevent clogging.

The city's existing water supply and quality for industrial water users could be maintained by constructing an infiltration gallery, a new inlet and settling basin, additional Ranney wells, or a diversion inlet with chemical pretreatment and a settling basin. Improving or adding to the treatment facilities currently used by the mills could be another option to protect water quality.

Water supplied to the tribal fish hatchery would be protected if the existing infiltration pipe was relocated, a new or additional infiltration gallery was built and the original protection dike was enlarged to control changes in the channel.

During public review of the Elwha Report, several homeowners expressed concerns that their property could be subject to flooding and degraded water quality if the dams were removed. Mitigation measures, including reinforced levees, which would mitigate impacts to water quality for the Elwha Place Homeowners Association will be evaluated in the Implementation EIS. The Dry Creek Water Association's water supply could be protected by replacing two of their wells closest to the Elwha River. Mitigation for other private well users is also being investigated.

In order to protect the water supplied to the WDFW fish rearing channel, diversion facilities could be reconstructed to facilitate fish passage and downstream sediment transport. A flood protection barrier could also be constructed between the river and the rearing channel.

Raising the U.S. Army Corps of Engineers flood control levee up to four feet along its most downstream reach and armoring it with riprap or other material would maintain the 200-year flood level of protection for residents against

possible additional downstream flooding and meandering of the river (U.S. Army Corps of Engineers, 1994). A second homeowner's levee on the west side of the same part of the Elwha floodplain might also need to be raised or armored.

Cumulative Impacts

Cumulative impacts are those which have an additive affect on river morphology or water quality in the Elwha River. These are existing impacts from actions outside those proposed or connected to those in this draft EIS or the Implementation EIS.

Water quality in the lower Elwha River does experience some degradation from other sources. Indian Creek, a major tributary which enters the Elwha above Lake Aldwell, drains a watershed which has been logged and farmed. Little River, another tributary above Elwha Dam, travels through a watershed which is highly disturbed by logging. Both of these streams bring sediment and may carry trace quantities of pesticides, fertilizers or other contaminants.

Conclusions

The riverbed may be one to five feet lower and more channelized because of the dams. Water is generally clear and of high quality, although it is cloudy during rainy or high flow seasons. Releases from the dams have increased water temperatures from 2° to 4° C than under pre-dam conditions. All alternatives except **No Action** could result in some short term increases in turbidity. The temporary increases in turbidity following dam removal depend on the selected sediment management approach. If sediment is allowed to erode naturally, a large portion of the 14 to 15 million cubic yards of silt, clay, gravel, sand, cobbles and boulders built up behind the dams could find its way into the river. This could negatively affect or kill fish as well as their eggs and habitats. Although more expensive, mechanically removing sediments or stabilizing them in place would result in little or no additional sediment flow over pre-dam conditions in the short term.

Removing both dams would reintroduce spawning gravel and nutrients for fish and return the river to a meandering, dynamic state. It would also result in pre-dam water temperatures, and could raise the riverbed and result in localized flooding. Removing just Glines Canyon Dam would do much the same, but would not return sand and gravel to the estuary, beaches, or Ediz Hook in the foreseeable future. These features would continue to erode unless both dams were removed. Removing only the Elwha Dam would not substantially change river morphology or water quality over existing conditions in the long term.

Native Anadromous and Resident Fisheries

Because the impacts to native anadromous fish are rated somewhat differently in the FERC EIS than in the Elwha Report, a discussion of DOI's methodology for assessing impacts is presented below. Although impacts to each "run" of salmon and trout are summarized in this document, sections which treat all species together precede the discussion. This is to help readers who do not want or need to read species specific impact sections.



DOI Impact Methodology

In assessing impacts to native anadromous fish under each alternative, the FERC EIS and Elwha Report look at four primary factors: available stock; ability for adults to pass over the dams as they migrate upstream and juveniles to pass downstream on their way to the sea; the condition of the stream habitat; and marine fishing pressure.

Restoration potential for each run is classified based on how successfully the run was rated under each of these factors, similar to the approach used by FERC. However, there are some differences. FERC rates losses less than 20 percent for passage mortality as "favorable", while DOI disagrees and believes mortality should be kept as low as technologically possible (in the 2 to 5 percent range). Further, the availability of native Elwha River genetic stock is not as important in driving restoration potential, since the Elwha Report has identified several alternative sources of genetic material DOI believes to be appropriate for restoring runs.

With the above caveats, DOI generally agrees with the following rating:

Any rated as "none"	=	No chance of restoration
Any rated as "unfavorable"	=	Poor chance of restoration
Two or three factors "marginal"	=	Fair chance of restoration
Two factors "favorable"	=	Good chance of restoration
Three factors "favorable"	=	Excellent chance of restoration

The Elwha Report assumes either dam would be mitigated to a greater degree if left in place than did FERC. These mitigation measures include increased flows over the Glines Canyon Dam spillway, screens on a relocated water intake at Glines Canyon Dam, and the importation of gravel to the middle and lower river if Glines Canyon Dam is not removed. Even so, the Elwha Report predicts poorer chances of restoring most runs than the FERC EIS did with either dam left in place (Elwha Report, pp. 36-58, 96-105, Appendix G). Since the Elwha

Table 2. Restoration Potential of Elwha Salmonids for Each Alternative

Dam Removal Alternative	Factors Contributing to Salmonid Restoration Potential				Salmonid Restoration Potential
	Factor Remains Constant	Factors Varying Per Alternative			
	Stock Availability	Ability to Withstand Fishing Pressure	Upstream Passage	Habitat Quantity & Quality	
Retain Both Dams					
Summer/Fall Chinook	● ○/●	● ○	○ ○	○ ○	poor
Spring Chinook				● ○	poor
Coho	● ○	○ ○/●	● ○	● ○	fair
Winter Steelhead	● ○/●	● ○	● ○	● ○	fair
Summer Steelhead		● ○	● ○	○ ○/●	fair
Pink Salmon	○ ○/●	● ○		○ ○	none/poor
Chum Salmon	● ○	● ○		○ ○	none/poor
Sockeye Salmon	○ ○/●	● ○	○ ○/●	○ ○/●	none/poor
Searun Cutthroat	unknown	● ○	unknown	● ○	unknown/poor
Searun Char	● ○	● ○	unknown	● ○	unknown/poor
Remove Glines Dam					
Summer/Fall Chinook	● ○	● ○	○ ○	○ ○	fair/good
Spring Chinook	○ ○/●	● ○	● ○	○ ○/●	fair/good
Coho	● ○	○ ○/●	○ ○/●	○ ○/●	fair/good
Winter Steelhead	● ○/●	● ○	○ ○/●	○ ○/●	good
Summer Steelhead	● ○	● ○	○ ○/●	○ ○/●	good
Pink Salmon	○ ○/●	● ○	○ ○	○ ○/●	none/poor
Chum Salmon	● ○	● ○	○ ○	○ ○/●	none/poor
Sockeye Salmon	○ ○/●	● ○	○ ○/●	○ ○/●	none/poor
Searun Cutthroat	unknown	● ○	unknown	● ○	unknown
Searun Char	● ○	● ○	unknown	○ ○/●	unknown
Remove Elwha Dam					
Summer/Fall Chinook	● ○	● ○	● ○	○ ○/●	poor/fair
Spring Chinook	○ ○/●			○ ○/●	poor/fair
Coho	● ○	○ ○/●	● ○	○ ○/●	fair
Winter Steelhead	● ○/●	● ○	● ○	● ○	fair
Summer Steelhead	● ○	● ○	○ ○	○ ○	fair
Pink Salmon	○ ○/●	● ○	○ ○/●	○ ○/●	poor
Chum Salmon	● ○	● ○	○ ○/●	○ ○/●	poor
Sockeye Salmon	○ ○/●	● ○	● ○	○ ○/●	poor/fair
Searun Cutthroat	unknown	● ○	unknown	○ ○/●	unknown
Searun Char	● ○	● ○	unknown	○ ○/●	unknown
Remove Both Dams					
Summer/Fall Chinook	● ○	● ○	● ○	● ○	excellent
Spring Chinook	○ ○/●	● ○	● ○	● ○	good
Coho	● ○	● ○	● ○	● ○	good/excellent
Winter Steelhead	○ ○/●	● ○	● ○	○ ○	excellent
Summer Steelhead	● ○	● ○	● ○	● ○	good
Pink Salmon	○ ○/●	● ○	● ○	● ○	good
Chum Salmon	● ○	● ○	● ○	● ○	good
Sockeye Salmon	○ ○/●	● ○	● ○	○ ○/●	poor/fair
Searun Cutthroat	unknown	● ○	● ○	○ ○	good
Searun Char	● ○	● ○	● ○	● ○	good

KEY

- Favorable
- /● Marginal
- Unfavorable

Report contains more current information than the FERC EIS, this document has summarized material from the Elwha Report when there is a discrepancy between the two.

Summary of Affected Environment

All species of native anadromous fish are presently kept from accessing over 70 miles of the Elwha River and usable tributaries by Elwha Dam. This confines them to the 4.9 miles downstream of the dam, known as the lower river. This habitat is in poor condition: water temperatures are abnormally high during summer and early fall; spawning fish are unnaturally crowded and subject to disease; nutrient flow necessary for invertebrate (food) production and the transport of large woody debris important for cover during the winter is diminished; spawning gravels essential for successful natural reproduction are missing because they are trapped in each reservoir; and the estuary is reduced in size and complexity.

Hatchery operations below Elwha Dam presently produce steelhead, Chinook and coho salmon, although there is some natural spawning of each of these and other species in the lower river.

Summary of Impacts

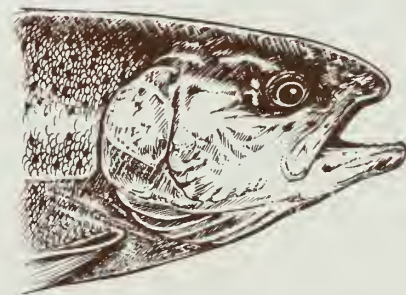
Impacts All Native Anadromous Fish Share

There are some common impacts all species would experience. For instance, one of the DOI goals (see "Purpose and Need" chapter of this document) is to fully restore Elwha River native anadromous fisheries.

If both dams are removed and sediment allowed to erode naturally, some portion of the 14 to 15 million cubic yards of sediment stored behind the dams could wash downstream. The fine clays and silts could smother adult fish at high concentrations, or fill the spaces between spawning gravels, thereby limiting dissolved oxygen concentrations necessary for incubating salmon and trout eggs.

The degree and timing of sediment releases into the river, and thus the impacts on native anadromous fish, would depend on the selected dam removal and sediment management scenario. Several alternatives for each are examined in the Elwha Report as required by Congress in the Elwha River Ecosystem and Fisheries Restoration Act (Public Law 102-495). A few of these methods will be expanded and analyzed in the second Implementation EIS.

If both dams are removed and most of the accumulated sediment is washed out by winter storms within one year, there is the potential for loss of an entire



"brood year" of naturally spawned native anadromous fish, although multiple year classes of some fish and efforts to remove some fish to hatchery facilities would mitigate this loss. If dams are removed sequentially and sediment managed via downstream coffer dams or stabilized on site, adverse impacts to fish would be further limited. Dredging would substantially reduce the amount of sediment entering the river.

Summary of Species-Specific Impacts

As explained above, four factors were evaluated to determine a species' chances of restoration. One of these factors - available stock - remains constant regardless of the alternative.

Availability of suitable stocks are considered:

"favorable" for summer/fall Chinook salmon;

"marginal/favorable" for winter steelhead;

"marginal" for coho and chum salmon, summer steelhead and searun char;

"unfavorable/marginal" for spring Chinook, pink and sockeye salmon; and

"unknown" for searun cutthroat trout. (See Elwha Report, Appendix G).

Passage mortality varies among species, but pink, chum and sockeye salmon are expected to encounter the most problems with Elwha Dam. Both pink and chum salmon produce juveniles that begin migrating downstream within hours of hatching. Because they are very small, they would be unable to effectively negotiate the reservoirs and could suffer significant mortalities at screens proposed for the penstocks. If Elwha Dam is removed, pink and chum would at least have the middle stretch of river between dams to use without having to surmount a dam or its reservoir, although habitat quality would be poor.

Sockeye salmon smolts lose their scales at a higher rate than all other salmon species, and descaling during passage at Elwha Dam could be significant.

Removal of Elwha Dam would allow sockeye salmon unimpeded access to Lake Sutherland.

Based on studies conducted at Lake Mills, spring and summer/fall Chinook salmon juveniles would likely suffer significant losses migrating downstream through the reservoir and past Glines Canyon Dam. Also, a large number of adult spring Chinook salmon would die while migrating upstream past fish passage facilities (i.e., the trap-and-haul facility at Glines Canyon Dam) because these fish are sensitive to handling following their entry into freshwater. Passage survival is rated as "unfavorable" for spring Chinook if both dams or only Glines Canyon Dam are retained. Summer/fall Chinook salmon are more tolerant of handling so are rated "marginal" if only Glines Canyon is retained.

Research and experience with searun cutthroat trout and char at fish passage facilities is limited. Further investigation is necessary to define the criteria

necessary for effective fish passage of these fish. Until then, DOI has rated the ability of these fish to surmount the facilities proposed for the Elwha and Glines Canyon Dams as "unknown".

Pink, chum, sockeye, spring and summer/fall Chinook salmon, searun cutthroat trout, and char have poorer chances for restoration under the mitigated "**Dam Retention**" alternative (Elwha Report, p. 35) than if one dam is removed. Only coho salmon, winter steelhead, and summer steelhead are thought to have even a "marginal" chance of surviving passage, and are rated as having "fair" restoration potential if both dams remain. In all **Dam Retention** alternatives, passage survival limits chances of restoration.

The third factor, habitat, is particularly important to the long-term sustainability of all runs of salmon and trout. Currently, both the middle and lower sections of the river have very little spawning-size gravel the fish need to lay their eggs. Water temperatures are higher than under pre-dam conditions because the still waters of the reservoirs are warmed by the sun and so store heat, which is later released downstream. The two dams also limit the downstream transport of nutrients and woody debris essential to aquatic invertebrates and fish. Glines Canyon Dam bars the natural river flow into the middle reach as well as the lower 4.9 miles below Elwha Dam; these conditions would continue under the **No Action**, **Dam Retention** (with mitigation), or **Removal of Elwha Dam** alternatives.

Removal of the Glines Canyon Dam would restore habitat in the middle stretch of river between the dams and allow natural transport of nutrients and debris as far as Elwha Dam. **Removal of the Elwha Dam** would release the up to 4 million cubic yards of sediment deposited in Lake Aldwell, but would not affect the significant amounts of sediments, nutrients or woody debris trapped in Lake Mills. The gravel released by removing Elwha Dam would also likely wash out to sea, returning the lower river to its present degraded state.

With the **Proposed Action**, habitats would improve to pre-dam conditions over the long-term for all species except sockeye salmon. Sockeye require a freshwater lake for completing their lifecycle, and the only one accessible from the Elwha River, Lake Sutherland, is highly developed along its shoreline. This means habitat is already in a degraded condition and removal of the dams would not significantly restore it.

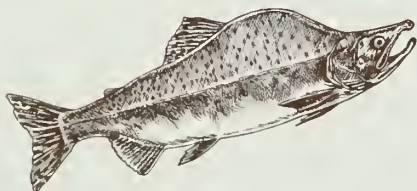
Of the four factors evaluated, fishing pressure is a regional concern which is not directly addressed in the Elwha Restoration Act. This will be discussed further under "Cumulative Impacts" at the end of this section.

Restoration Potential by Run

Although this draft EIS will treat some species separately, there are runs which would experience similar problems in traversing the dams and so are analyzed as groups. The following sections generally compare impacts to passage first, and then to habitat, for each of the alternatives.

Pink and Chum Salmon

Affected Environment. Pink salmon enter the river from July through September, and chum in October and November (see Table 3). Both spawn almost immediately, using smaller sized gravels. The traditional spawning grounds for pink and chum salmon are thought to have been limited to the lower 16 miles of the Elwha River. In addition, pink and chum generally spawn in low gradient side channels and tributaries. The two dams block the transport of spawning gravel to the stem river, limiting effective spawning of pink and chum salmon below Glines Canyon Dam.



Juveniles swim toward the sea within hours or days of hatching, and usually do not feed on their journey. Because they are so small, they cannot swim as well as older juveniles of other species and are primarily swept passively to the river mouth by the downstream current. Juveniles of both species usually spend up to two months maturing in estuaries, brackish pools at the mouth of rivers, or nearshore marine habitat. This habitat is also degraded and reduced in size as a result of the lack of sediment passing down the Elwha.

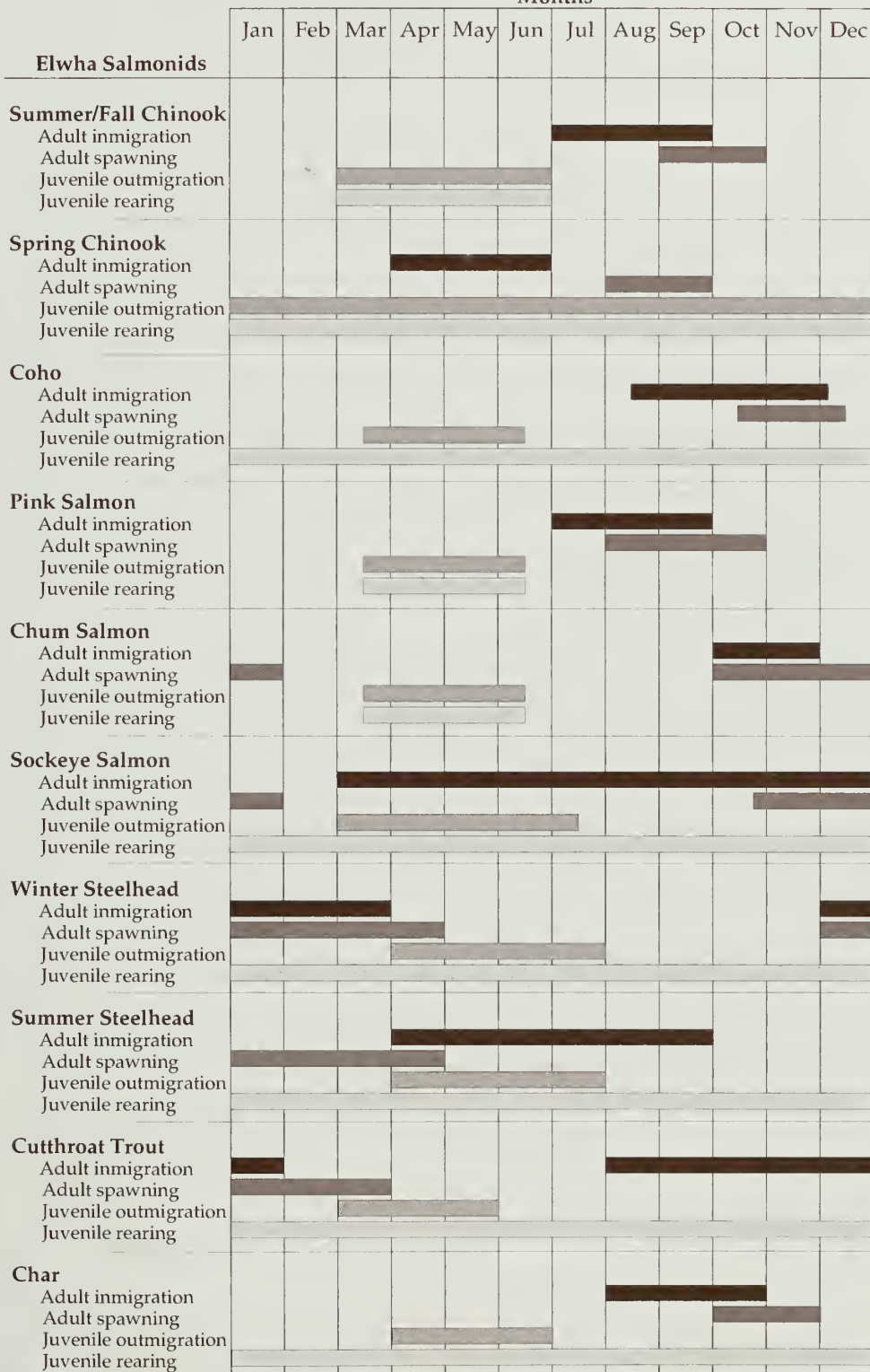
Chances of finding the original native stock for pink salmon are considered unfavorable, although the neighboring Dungeness River supports two stocks of pink salmon, at least one of which could flourish in the Elwha River. A small population of native chum remains in the Elwha River.

Impacts. Impacts to pink and chum salmon under both the **No Action** and **Dam Retention** (with mitigation) alternatives include the inundation of valuable riverine habitat by the reservoirs and the lack of spawning gravels in the middle and lower river.

Adults may sustain losses while passing over the dams on their way upstream, but it is the juveniles who are most at risk under any action alternative which retains at least one dam. These small fish cannot navigate their way quickly through either reservoir because the currents do not have the water velocity needed for juvenile migration. A portion would starve before reaching the spillways while many others would be susceptible to predation. Although screens to keep fish from being sucked into the turbines at each dam could potentially be sized to keep juvenile pink and chum salmon out, a survey of dams in the Pacific Northwest revealed no self-sustaining populations of pink or chum salmon above dams or reservoirs (J. Meyer, Olympic National Park, personal communication, July, 1994).

Table 3. In-River Life Cycle Stages of Elwha Salmonids

Months

**KEY**

-  Adult immigration
-  Adult spawning
-  Juvenile outmigration
-  Juvenile rearing

Catches of chum salmon are limited, despite being the target of some fisheries in the Strait of Juan de Fuca. It is estimated that five percent of Elwha River chum are harvested in U.S. and Canadian coastal waters, and 10 percent taken in the Strait of Juan de Fuca and Puget Sound. Up to 100 chum are caught incidentally in the Elwha each year (Elwha Report, pp. 16-17).

Between 15 percent and 49 percent of Strait and Elwha River pink salmon are taken in Canadian and U.S. coastal fisheries before they return to the strait to spawn, an additional 10 percent to 15 percent are taken in Strait marine fisheries. No in-river pink salmon fishery exists.

With **Removal of the Elwha Dam**, several miles of unobstructed river are opened to pink and chum in their traditional spawning grounds. Although they are expected to fare slightly better under this scenario than either the **Removal of the Glines Canyon Dam** or **Dam Retention** (with mitigation) alternatives, the habitat available to them would still be nearly devoid of spawning-sized gravel because of Lake Mills.

For these reasons, the chances of restoring pink and chum salmon are rated as “none/poor” or “poor” under all alternatives except the **Proposed Action**, where each is given a “good” chance for restoration.

Searun Cutthroat Trout and Char (Dolly Varden and Bull Trout).

Affected Environment. Cutthroat primarily use tributaries to spawn and rear whereas char may use tributaries or the main stem river. Except for portions inundated by the two reservoirs, the tributaries are generally in excellent condition. However, the mainstream habitat below Glines Canyon Dam is in poor condition as a result of trapped gravel in the reservoirs, elevated water temperatures, and the limitation of nutrient and woody debris flow.

It is unknown whether original native stock exists for these species. A large population of resident (no sea migration) native char and a smaller population of cutthroat trout exist above Lake Mills. Some of these residents apparently retain the ability to produce juveniles which undergo physiological changes allowing them to exist in a saltwater environment (e.g. become smolts), and in fact may be descendents of the original Elwha seagoing race. These resident populations may be usable as brood stock to reestablish seagoing runs of both of these species. DOI has therefore rated stock availability as “marginal” for searun char and “unknown” for cutthroat.

Impacts. These species could have problems passing over the dams. Adults are smaller than native anadromous salmon and might not be able to ascend the ladder designed for larger fish at Elwha Dam (Elwha Report, p. 56). Additional investigation is necessary to determine the fish passage criteria for these fish.

Neither cutthroat nor char adults necessarily die immediately after spawning, but instead often return to the sea. Cutthroat trout may swim upstream without spawning, return to the ocean, and come back the next summer or fall to spawn. Fish screens proposed by FERC and the Joint Fish and Wildlife Agencies (JFWA - U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service, National Marine Fisheries Service, Washington Department of Wildlife and Fisheries, Point No Point Treaty Council and the Lower Elwha S'Klallam Tribe) to prevent juvenile salmon and trout from entering the turbines may not work well for adult-sized trout, so losses are expected in their downstream migration as well. No tests have been performed to see whether these seagoing trout can negotiate the dams, and so their ability to withstand passage is "unknown".

The availability and condition of habitat is a potential problem if the dams remain in place. Some of the prime tributaries usable by cutthroat trout are blocked or inundated by Lake Mills, or lie between the dams. **Removal of the Elwha Dam** or the **Proposed Action** would allow cutthroat access to the tributary habitat between the dams, and habitat is rated at a higher quality under this alternative than removing Glines Canyon Dam.

Although char prefer main channels, this habitat is in poor condition in both the lower and middle river and would not be fully restored unless both dams are removed. Habitat is rated as "marginal" with both dams in place and "marginal" to "favorable" if one is removed.

Chinook and Coho Salmon and Steelhead Trout

If the dams are removed, each of these species have either a "good" or "excellent" chance for restoration. The pre-dam Elwha River supported early runs and later summer and fall runs of Chinook salmon. The same is true for steelhead, which swim up the Elwha from December through February (winter steelhead) and March through August (summer steelhead). Summer and winter steelhead, and spring and summer/fall Chinook are distinct "races" of fish.

Chinook

Affected Environment. Before the dams were built, it is believed that Chinook entering the river in the spring swam further upriver and spawned upstream of Carlson Canyon Falls at RM 34. Those fish that entered in the late summer or fall spawned downstream of RM 34. Adult Chinook die within weeks of spawning, and the juveniles may stay in the Elwha for three months to more than a year before migrating to the sea. All juveniles spend some time in the estuary as they grow and adapt to saltwater. Estuary size is shrinking, however, due to sediment trapped behind the dams.

A suitable stock of summer/fall Chinook is presently available since this variety is maintained in Washington State hatchery facilities. However, a separate spring entry of spring Chinook could be missing altogether in the Elwha River. The



genetics of Elwha spring Chinook presumably remain intact in the summer/fall stock (Brannon and Hershberger, 1984). Fully restoring the summer/fall run and making spring Chinook habitat available upstream of RM 34 is considered likely to result in separation of the two stocks. For all alternatives, the stock availability for summer/fall Chinook was classed "favorable" and for spring Chinook as "unfavorable/marginal" (see Table 2).

Impacts to Chinook. FERC estimates that about 6,900 Chinook once used the Elwha for spawning and could use it again, producing a run size of over 31,000 fish (FERC EIS, p. 4-150). Currently, and under the **No Action** alternative, between 2,000 and 4,000 hatchery Chinook return to the 4.9 miles of river below Elwha Dam. This creates crowded conditions for the spawning adults, with approximately five times the density of redds (nests) per river mile as is optimal (FERC EIS, p. 3-33).

Since 1960 the lower Elwha has been supplemented with hatchery Chinook salmon, which have been, for the most part, native stock. However, some spring Chinook have been planted in the river from the nearby Dungeness and Soleduck River hatcheries.

Each year a limited number of Chinook (150) are harvested from the Elwha River; they are primarily harvested in fisheries along the northwest coast and about 61 percent are harvested in commercial fisheries in the marine environment (Elwha Report, p. 16).

Juvenile Chinook are expected to experience relatively high mortalities passing through the reservoirs and over both Elwha and Glines Canyon Dams. Juvenile Chinook need a swift current to help them navigate their way to the ocean, yet reservoirs do not create such a current. Resident trout in these reservoirs feed on the juvenile Chinook, reducing the population, during the downstream migration. Elevated water temperatures under the **No Action** and **Dam Retention** (with mitigation) alternatives would continue to result in increased adult mortalities resulting from diseases in the lower river. Spring Chinook, which are particularly sensitive to handling after entering the freshwater environment, encounter the trap-and-haul process at a point 13 miles upstream (Elwha Report, p. 54). Some summer/fall Chinook who enter the river when flows are low and temperatures are high would die as a result of handling.

More Chinook losses are expected as a result of Glines Canyon Dam and Lake Mills than from Elwha Dam and Lake Aldwell. The **Dam Retention** (with mitigation) and the **No Action** alternative result in losses estimated in the 60 percent range for both spring and fall Chinook. Removal of only the Elwha Dam reduces this to about 30 percent, while removal of only the Glines Canyon Dam only reduces it to around 15 percent (FERC, p. 4-192). The **Proposed Action** would result in no fish being lost through passing dams or reservoirs.

Chinook salmon require cool water (below 14° C) and medium-size spawning gravel. They usually lay their eggs in a main channel of the river rather than its side channels or tributaries. Habitat for the spring Chinook is relatively intact since it is located upstream of both dams. However, sections of the river below the dams in which fall Chinook would normally spawn are nearly devoid of spawning-sized gravel, and water temperatures in the summer and early fall are higher than pre-dam temperatures. This can kill Chinook eggs directly and aggravate *Dermocystidium*, a potentially lethal disease for fish.

Under either the **No Action** alternative or the **Dam Retention** (with mitigation) alternative, Chinook would be lost due to high water temperatures and disease (documented losses as high as 60 percent). Spring Chinook spawning habitat would remain in favorable condition but an inaccessible location.

Removal of the Elwha Dam could temporarily send sediment into the lower river and result in fish kills, but it would also alleviate crowded conditions and reduce incidents of *Dermocystidium*. (See Table 2).

Removal of the Glines Canyon Dam would release sediment into the middle stretch of the Elwha River, reseeding the area with spawning-size gravel and allowing temperatures to return to pre-dam conditions (Elwha Report, p. 46). No spawning gravel would make it to the lower river however, and the transport of nutrients and woody debris would continue to be limited.

With the **Proposed Action**, depending on the sediment management regime selected, high sediment loads could result in direct losses of adult fish and reduce effective spawning in the short-term. Over the long-term, however, the entire river would return to natural sediment transport processes and the middle and lower river would experience a reduction in temperatures to pre-dam levels and be fully supplied with spawning gravels, nutrients and woody debris. The nutrients would support the invertebrates on which most species of native anadromous fish feed. Habitat is ranked "favorable" for both races of Chinook if the dams are removed.

Overall chances for restoring fall and spring Chinook in the Elwha are rated "poor" if both dams are retained, "fair/good" if only Glines Dam is removed, and "poor/fair" if only Elwha Dam is removed. Restoration potential increases to "good" for spring Chinook and "excellent" for summer/fall Chinook if both dams are removed.

Coho

Affected Environment. Coho enter the Elwha River from August through December and spawn in the late fall and winter. Juveniles live in the river for over a year after hatching before they migrate to sea in their second spring. Adults spawn in tributaries and mainstream river channels which do not slope more than one or two percent, and juveniles live in pools, ponds, and backwater areas before they leave the river. Adults die shortly after spawning.



Suitable stock is available both in the river and in the hatchery, and is rated "marginal" by DOI.

Impacts to Coho. Coho have been raised in hatchery operations since 1965, which include plantings from the Dungeness River from 1967 to 1976. The state rearing channel was used to rear and release coho from 1974 to 1982. The Elwha tribal facility has been releasing coho since 1977, and has been the only source of hatchery coho since 1983. Since 1977, coho returns have ranged from 5,000 to 18,000 per year, with the majority being hatchery fish.

About 77 percent of the Elwha River coho were taken from marine waters during the years 1984 to 1991. About half of these were harvested by Canadian fisheries, and the other half by U.S. fisheries proportionally split 70 percent in marine waters, 20 percent in coastal areas and 10 percent from the Strait of Juan de Fuca. The Elwha S'Klallam Tribe takes fewer than 2,000 coho per year.

Important pond and backwater areas are currently inundated by the two reservoirs. Thus, the transport of woody debris, important in the formation of pools and winter habitats, is limited because of the two dams. These are ongoing impacts which would continue to negatively affect coho under all action alternatives except the **Proposed Action**.

Like Chinook, adult coho are expected to experience some losses passing the fish ladder at Elwha Dam and surviving the trap-and-haul procedure at Lake Mills. Some juveniles would remain in the reservoirs (residualize) and many would not make it to the dams before they were eaten by predators. A percentage of those who do make it to the dams would be lost either going over the spillways or through the turbines. Estimates in the FERC EIS predict about 30 percent losses from passage of adult and juvenile coho compared to around 50 percent for Chinook (FERC EIS, p. 4-22). DOI rates the coho's ability to survive passage as "marginal" if both dams remain, i.e. **Dam Retention** (with mitigation).

The Eicher screens proposed to route salmon and trout away from Elwha Dam turbines were generally successful in tests involving juvenile coho, so losses from downstream migration are expected to be higher with the **Removal of the Elwha Dam** alternative than the **Removal of the Glines Canyon Dam** alternative. However, additional tests of the Eicher screen with smaller coho

are needed to determine passage effectiveness for these fish. Screens proposed by the JFWA for the Glines Canyon Dam intake would reduce losses of juvenile coho, but losses from navigating the spillways and residualism (i.e. disorientation and delay in the reservoir) would remain (Elwha Report, p. 35). Ability to withstand mortality from passage is rated as "marginal" for both single dam alternatives. In the case of the **Proposed Action**, passage problems are eliminated for all fish.

Coho prefer spawning in tributaries which are not too steep, but will also use the main river. Coho habitat exists in the river now (i.e. **No Action** alternative) upstream of the Lake Mills delta, but habitat in the middle and lower reach not inundated by the reservoirs is either too steep or does not have the small gravel coho need for spawning. Under the **No Action** and **Dam Retention** (with mitigation) alternatives, the water in the middle reach is also warmer, has fewer nutrients, and does not have the large logs and other debris juveniles seek for winter cover.

Removal of the Glines Canyon Dam would reseed the middle reach with small gravel, and in the long-term would provide several miles of low gradient spawning habitat in the main channel. Woody debris needed for overwintering juveniles would be released naturally throughout most of the river, but would be limited in the lower Elwha. For those adult coho that pass over Elwha Dam, nearly 65 miles of tributary and main channel habitat (coho are not expected to pass Carlson Canyon Falls) would be available for spawning (FERC EIS, p. 4-24). At present, only the 4.9 miles of mainstream river are available for coho to spawn and rear, and the habitat in these miles is in very poor condition.

Removal of the Elwha Dam would provide some gravel to the lower Elwha River, would eliminate passage mortality up to Glines Canyon Dam, would restore 2.5 miles of currently inundated, low gradient river and would allow access to 8.5 additional miles of habitat. The entire middle stretch would remain gravel deficient and the lower stretch would eventually return to its present poor condition as sediments from behind Elwha Dam are washed out to sea.

For both the **No Action** and **Dam Retention** (with mitigation) alternatives, the problems described above become additive. The middle and lower river would remain gravel starved with important tributary space inundated and woody debris would continue to be blocked and unavailable for juvenile coho as they winter in the Elwha River. Habitat is rated as "marginal" for coho under either alternative.

Overall chances for restoration are: "none" for **No Action**; "fair" for **Dam Retention** (with mitigation); "fair/good" for **Removal of the Glines Canyon Dam**; "fair" for **Removal of the Elwha Dam**; and "good/excellent" for the **Proposed Action**.

Ability to withstand mortality from passage is rated as "marginal" for both single dam alternatives.

*The Elwha
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Steelhead

Affected Environment. Steelhead are, essentially, a searun race of rainbow trout. Winter steelhead enter the Elwha in December through February, and summer steelhead migrate upstream from March through September. Both races spawn in the spring. Most juveniles rear in the river for two years before migrating to the ocean, although many may rear for one to three years. Approximately five percent of adults migrating upstream have spawned before. Adults which spawn and return to the ocean are called “kelts” on their trip out to sea.

Steelhead adults use a wider size range of spawning gravel than coho or Chinook. They are also able to spawn in mainstream rivers or tributaries. Steelhead are not expected to have trouble negotiating Carlson Canyon Falls, and, like Chinook, this is assumed to be the pre-dam separation point of winter and summer runs. The summer run uses habitats upstream of these falls for spawning while the winter run spawns downstream of the falls.

The Elwha has been stocked with hatchery steelhead since 1965, but a native Elwha River winter steelhead remains. It is identified by its later entry (February through March) into the river than hatchery stock.

Although the native Elwha River winter steelhead is differentiated from hatchery stock by its late entry, summer steelhead stock is not as easy to identify, since there is no apparent seasonal separation of transplanted, non-native, hatchery stock. DOI is investigating the likelihood of using rainbow trout from the Elwha River above the dams to create a summer steelhead run. These fish are native to the Elwha and may be descendants of summer or winter steelhead. Stock availability for winter steelhead is rated “marginal/favorable” and “marginal” for summer steelhead.

Impacts to Steelhead. Because of the hatchery operation, the Elwha S’Klallam Tribe operates a commercial in-river fishery for steelhead. Steelhead harvests average about 3,200 fish per year for the tribe (Elwha Report, p. 17). About 3,800 winter adults enter the river to spawn and an average of 80,000 hatchery smolts are released each year (FERC, p. 3-41). Sports fishers harvest about 1,150 winter steelhead and about 460 summer steelhead each year.

Steelhead are expected to withstand passage losses from **Dam Retention** (with mitigation) about as well as coho salmon. The outmigrating juveniles would be relatively large, strong swimmers who are not expected to be preyed upon heavily in the reservoirs. Adult losses during upstream fish passage would be about the same as the coho salmon. Kelts that migrate back to sea after spawning may encounter low flow conditions, and consequently, some losses are expected. As with coho, steelhead juveniles would experience some mortality from predation and other factors as they mature in the river, and some would residualize in the reservoirs. Some mortalities would occur during passage past fish screens (FERC EIS, p. 4-25).

Removal of the Glines Canyon Dam would resupply the middle stretch of the Elwha with spawning gravel as well as woody debris. However, the lower Elwha would continue to be gravel starved, and important riverine habitat inundated by Lake Aldwell would not be restored. As with coho salmon, this combination results in a “marginal to favorable” rating for steelhead habitat under this alternative.

Removal of the Elwha Dam would resupply the lower river with gravel from the sediments built up behind Elwha Dam resulting in a short-term improvement in habitat as these sediments would eventually be washed out to sea. Gravel, some woody debris and nutrients would remain trapped behind Glines Canyon Dam and 2.8 miles of riverine habitat would continue to be inundated by Lake Mills. Summer steelhead habitat above Glines Canyon Dam would remain intact and in excellent condition. However, adults and juveniles would need to negotiate poor quality habitat in the lower and middle reaches. For these reasons, habitat is rated as “marginal” for both winter and summer steelhead.

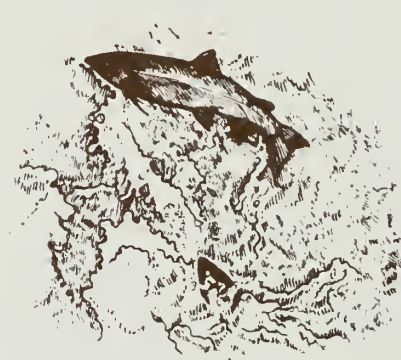
The **Proposed Action** eliminates problems with passage and fully restores the habitat for winter and summer steelhead.

Sockeye Salmon

Affected Environment. Sockeye salmon require a freshwater lake or lake-like environment to complete their reproductive cycle. The only natural lake accessible from the Elwha River is Lake Sutherland. It is drained by Indian Creek, a tributary of the Elwha which enters at RM 7.5, between the two dams. Lake Sutherland has been developed and spawning habitat in the lake or in tributaries upstream is in poor condition. For this reason, habitat for sockeye is rated as “unfavorable/marginal” under all scenarios.

It is unknown whether an original native stock of Elwha River sockeye exists. DOI is investigating whether the kokanee, a landlocked version of sockeye salmon which occupies Lake Sutherland, has the characteristics needed to use as a broodstock for Elwha River sockeye. Some of these kokanee may be descendants of Elwha River sockeye, but this is unknown and complicated by the many lake plantings of non-native kokanee. Chances of locating an appropriate stock are rated as “unfavorable/marginal.”

Impacts. Sockeye smolts tend to lose scales more easily than other native anadromous salmon (FERC EIS, p. 4-31), and would have more trouble negotiating the fish screens proposed for Elwha Dam. With **Removal of the Elwha Dam**, passage problems would be entirely eliminated since this species would veer off toward Lake Sutherland and not continue upriver to Glines Canyon Dam. Passage under both the **Removal of the Elwha Dam** or the **Proposed Action** is considered “favorable”, while it is considered “unfavorable/



marginal” for the **Removal of the Glines Canyon Dam, Dam Retention** (with mitigation) alternatives and “none” for the **No Action** alternative. Only **Removal of Elwha Dam** or the **Proposed Action** results in a “fair” chance for sockeye salmon restoration.

Resident Species

Affected Environment. Rainbow trout, native char, and small populations of cutthroat and brook trout occupy the upper Elwha. Rainbow trout also use the reservoirs and middle reach of the river. These are nonanadromous populations of trout, although the impulse for rainbow or native char to migrate to sea may remain.

Impacts. Reintroduction of native anadromous trout and salmon would increase competition for available food and habitat, and resident populations are expected to decline to historically low population levels. In the **Proposed Action** alternative, this loss would be completely offset through improved habitat and the increased number of native anadromous trout and salmon available for anglers. However, in the case of the **Dam Retention** (with mitigation) alternative, the restoration of native anadromous species would not make up for the loss of rainbow, brook and native char (FERC EIS, p. 4-68).

Cumulative Impacts

Cumulative impacts are those which add to impacts from the **Proposed Action** or alternatives. Harvesting salmon and trout in their marine environment has a cumulative effect on fisheries.

The management of fisheries is a regional concern, not directly addressed by the Elwha Restoration Act. A thorough description of fisheries management in Washington is located in the Elwha Report (pp. 15-17).

Fisheries management actions are flexible and are generally guided by the strength of key stocks. When runs are plentiful, more fish can be caught and so fisheries are increased. When runs are weak, less fish can be caught and fisheries are reduced. In some cases, a complete closure of fisheries is needed as was seen in 1994 when large areas of the marine waters of California, Oregon, and Washington were closed to all salmon fishing.

The ability to achieve the restoration goals for the Elwha will require the prudent management of impacted fisheries in order to ensure that the necessary number of fish survive to spawn each year. The ability to achieve these numbers is directly dependent upon the size of each run.

Under any of the scenarios where the dams remain in place, the dams themselves reduce the number of fish, leaving fewer salmon and trout for harvest. Under each scenario where at least one dam remains in place, the ability to adjust

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fishing pressure to meet the needs of pink and coho salmon is rated as "unfavorable" or "marginal". Although fishing pressure on Elwha pink salmon is generally very low, the high number of pink salmon removed by the dams leaves virtually no fish for harvest. For coho salmon, the reverse is generally true. Numbers of Elwha coho salmon caught in Canada, along the Washington coast, and in the Strait of Juan de Fuca are large relative to the numbers taken by the dams.

Most other species are rated as "marginal" under any of the dam retention alternatives. That is, the number of fish taken by the dams can be more or less accommodated by changes in fisheries management. For summer and winter steelhead, cutthroat trout and native char, the effect of fishing pressure is rated as "favorable" under all alternatives. This is because almost all of the harvest of these fish takes place in the river where the flexibility to manage fisheries is the greatest.

Under the **Proposed Action**, the effect of fishing pressure is rated as "favorable" for all species except coho salmon, which is rated as "marginal". The "marginal" rating for coho is due to the need to move from a hatchery-based fishery (which doesn't require as many spawning fish) to a natural stock fishery (which requires more spawning fish). Making this change in management strategy may take several years.

Conclusion

Taking **No Action** would continue to provide 4.9 miles of poor quality habitat for migrating salmon and trout. These populations would require management through hatchery supplements and would never be self-sustaining.

Dam Retention, with DOI-specified fish passage measures over both dams, would allow access to the middle and upper Elwha for some species, but would not improve habitat for fish in the middle or lower river. Coho, winter and summer steelhead have a "fair" chance for restoration if this alternative is implemented. The chance for restoration for all other species is either "none", "poor", or "unknown".

Removal of the Glines Canyon Dam would improve habitat quality in both the lower and middle river, and would eliminate passage mortality from the larger dam and reservoir. Mortality from Elwha Dam and Lake Aldwell would remain. Chances for restoring steelhead are "good" under this alternative. Both runs of Chinook and coho have "fair" to "good" possibilities for restoration under this alternative providing there are fish passage measures installed on Elwha Dam. Pink, chum, sockeye salmon and cutthroat, char (Dolly Varden and bull trout) have either "none", "poor", or "unknown" chances for restoration.

***For the
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Removal of the Elwha Dam gives the pink, chum and sockeye salmon, a better chance of restoration than either the **Removal of the Glines Canyon Dam** or **Dam Retention** (with mitigation) alternatives. However, most runs would experience difficulty passing over Glines Canyon Dam or utilizing the poor habitat in the middle stretch of river if the **Removal of the Elwha Dam** alternative is chosen. Chinook, coho and steelhead restoration is rated "poor" to "fair" if the Glines Canyon Dam remains and Elwha Dam is removed. The possibilities for reestablishing seagoing cutthroat trout or char is "unknown" for this alternative.

For the **Proposed Action**, passage mortality drops to zero and habitat along the entire river is restored, including the 5.3 miles of habitat now inundated by the reservoirs. All runs for which native stock is readily available have "excellent" chances for restoration; this includes winter steelhead and summer/fall Chinook salmon. Chances for restoring coho are "good" to "excellent" and "good" for all remaining runs except sockeye salmon. Because suitable sockeye stock is questionable and lake habitat is in poor condition, its chances for restoration are rated "poor" to "fair".

Living Marine Resources

Affected Environment

Living marine resources include shellfish, echinoderms, marine algae, fish and mammals (marine substrates are discussed in the section on sediment, river morphology, hydrology and water quality). Hardshell clams like littleneck, butter, and horse clams, are the most commonly pursued species in the area, although the season is often closed due to persistent red tide events (FERC, p. 3-47). Littleneck and butter clams prefer gravel- to boulder-sized substrate, while horse clams prefer sandy substrate. Species composition and abundance prior to dam construction is not known, however clams may have been more abundant than at present because of substrate changes due to bedload sediment starvation (Elwha Report, p. 15).



At the river mouth, the shore environment is composed primarily of cobbles and boulders, while the offshore bottom is mostly sand and gravel (Schwartz, 1994). A suspended sediment plume from the river's discharge drifts to either the northwest or to the northeast depending on tide and currents. To the east of the river mouth for about one mile, the upper beach is steep with high wave energy, and plant and animal use is limited. This beach area is composed primarily of cobbles with some gravel. The lower beach supports a healthy community of marine flora, including more than 20 species of brown, red and green algae, and a number of attached animals, such as snails, limpets, barnacles, mussels and chitons (letter from G. Ging, USFWS, August, 1994). Starting near RM 1, a natural band of actively eroding bluffs contribute large amounts of suspended sediments to the surf.

In general, the near-shore marine community includes fish such as salmon, greenling, flatfish, rockfish, sculpins, clingfish, sand lance, herring; more than 25 species of marine algae (including kelp); birds, including gulls, common murre, marbled murrelets, rhinoceros auklets and harlequin ducks; and mammals including the Pacific harbor seal, and infrequently Steller and California sea lions, orcas, and gray whales (Calambokidis, et. al., 1987; USFWS, 1994). Nearshore substrates composed of boulders and cobbles support species that prefer rocky environments, such as kelp, many species of red algae, red and yellow sponges, red rock crab, barnacles, mussels, limpets, chitons and periwinkles. Local kelp beds are particularly important as habitat for various species of baitfish, which are prey species for salmon.

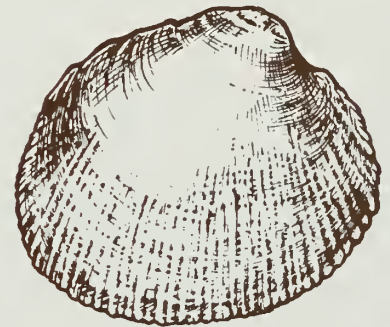
Impacts

Clam populations have been reduced by the steepening of beaches and the loss of sands and gravels due to the trapping of sediments behind the dams (Elwha Report, p. 60). For the **No Action**, **Dam Retention** (with mitigation) or **Removal of Glines Canyon Dam** alternatives, there would be no changes in the river's sediment output, and thus no changes in existing clam populations are expected (FERC, p. 4-34). The near-shore marine environment would continue to be dominated by species that prefer a rocky environment, i.e., kelp, rock crab, barnacles and mussels.

With **Removal of Glines Canyon Dam**, sediments would either be stabilized within the reservoir area or be trapped behind Elwha Dam. They would not affect the marine environment, and no changes in near-shore or estuary areas would be expected. In the very long term, sediment transport may be restored after Lake Aldwell fills completely with sediment.

With **Removal of Elwha Dam**, up to 4 million cubic yards of sediment might be transported by the river to its mouth. This would have similar, but much less intense impacts on the marine near-shore environment as the **Proposed Action**. This volume of sediment would not be enough to restore the estuary or beaches to pre-dam conditions (Elwha Report, p. 51). These areas would likely continue to be dominated by species that prefer a rocky environment.

In the **Proposed Action**, the short term impacts to marine resources depends on the sediment management option selected. A range of options exist and will be examined in detail in the Implementation EIS. These options include allowing sediment to erode naturally, stabilizing it in place, and the mechanical removal and disposal in whole or in part at another, undetermined location. If sediment is naturally eroded, a portion of the 14 to 15 million cubic yards of stored sediment would eventually wash out into the river, delta and Freshwater Bay. This could cause intense short term impacts on the nearshore area east of Freshwater Bay by smothering vegetation and causing high turbidity in bay waters (Elwha Report, p. 40). This sediment would be rapidly carried eastward



by the prevailing current and overall effects are not expected to differ greatly from other river systems in the Pacific Northwest (FERC, p. 4-111).

In the long term, it is likely that populations of all three hardshell clam species would increase due to the increased sand and gravel sediment loads (FERC, p. 4-121). Marine mammals are not expected to be impacted by short term, increased sediment loads. Salmon and trout might be adversely affected by suspended silt and clay as they swim from the bay up the Elwha (see section on "fish" in this document).

It is estimated that restoring natural sediment loads to the river would eventually build the estuary out about one-half mile, making it similar or slightly larger than its pre-dam condition (Elwha Report, p. 41). Depending on the amount and distribution of sediment, near-shore and estuarine community substrates could be partially or completely changed from cobbles to an area dominated by sand and gravel. Plant and animal components would change accordingly (e.g., from kelp, rock crab, barnacles and mussels to eelgrass, Dungeness crab, and flatfish). The expanded estuarine environment would benefit juvenile salmon and trout as well as other marine species which use or reproduce in intertidal, brackish waters.

Cumulative Impacts to Marine Resources

With the significant exception of salmon stocks, there are few sources for negative impacts on marine resources in the region. Most of the coastal strip on the west side of the Olympic Peninsula is protected by Olympic National Park and by two national wildlife refuges. The north side of the peninsula, although not in protective land status, is relatively natural, affected primarily by sediment input from coastal logging activities. The east side on Puget Sound is affected by logging, residential, and industrial activities. The return of natural Elwha River salmon runs, and the expected restoration of the river's estuary, would positively affect the overall health of the marine environment.

Conclusions

If **No Action** is taken, or the **Dam Retention** (with mitigation) or the **Removal of Glines Canyon Dam** alternatives are adopted, the near shore marine community would be dominated by species which prefer a rocky environment, such as kelp, rock crab, barnacles and mussels. **Removal of Elwha Dam** could flush up to 4 million cubic yards of material into Freshwater Bay, and removing both dams could send up to 14 to 15 million cubic yards into the bay. Either of these alternatives might cause short term impacts through sediment loading to sessile (immobile) biota, such as shellfish or vegetation. In the long term, removing both dams could change the near shore and estuarine community to favor species which require a sandy substrate, such as eelgrass, Dungeness crab, flatfish and hardshell clams.

Vegetation and Wildlife

Vegetation

Affected Environment

The project area is within the western hemlock zone, the most extensive vegetative type in western Washington and Oregon (FERC EIS, p. 3-48). Forests are generally dominated by western hemlock and Douglas-fir. Elwha drainage supports a mix of plant species that is transitional between the wet western peninsula and the comparatively dry eastern peninsula. Other common woody species include Pacific madrone, grand fir, red alder, bigleaf maple, and manzanita. Eight vegetated land cover classes have been mapped in the vicinity: conifer forest, mixed forest, hardwood forest, deciduous shrub, grassland, palustrine (wetland) forest, palustrine shrub and palustrine emergent. At least 64 non-native plant species have been documented in the Elwha drainage within the national park (Elwha Report, p. 18).

Wetlands in the project area are limited to the three palustrine land cover classes. About 50 percent of their total acreage occurs in Sweets Bottom (an area along the river near the park boundary), while the largest wetland area (38 acres) occurs at the upstream end of Lake Aldwell (FERC, pp. 3-51 and 4-125). Wetland values include flood moderation, bank stabilization, sediment and nutrient retention, and wildlife habitat.

Impacts

Impacts from the **No Action** and **Dam Retention** (with mitigation) alternatives are similar. Under both alternatives, 715 acres of potential natural vegetation would remain inundated or lost due to the dams and their reservoirs. This acreage includes over five linear miles of low elevation riparian communities and natural wetlands. With **Dam Retention** (with mitigation), vegetation would be removed for construction of fish passage facilities at each dam site (Elwha Report, p. 58), and an additional 189 acres of vegetation around Lake Aldwell would be modified for wildlife mitigation.

Under the **Removal of Glines Dam** alternative, 425 acres at Lake Mills and the Glines Canyon Dam site would be reclaimed and eventually returned to pre-dam conditions. With the water table substantially lowered, about 4.7 acres of wetlands associated with Lake Mills boat launch would be lost, while 26 acres of new wetlands would be established along the reclaimed river channel. A minimal amount of vegetation would be lost at the Elwha Dam with the construction of a fish passage facility. Land at Lake Aldwell would be modified for wildlife mitigation including the creation of 8 acres of wetlands. A new campground at Lake Aldwell would disturb an additional 5 acres (Elwha Report, p. 47; FERC, pp. 4-165 and 4-46).



Under the **Removal of Elwha Dam** alternative, 290 acres at Lake Aldwell and the Elwha Dam site would be recovered to natural conditions. About 38 acres of wetlands at the delta of Lake Aldwell would be lost, while 22 acres of new wetlands would be established along the reclaimed river channel. A minimal amount of vegetation would be lost at Glines Canyon Dam with the construction of a trap-and-haul facility for fish mitigation.

The **Proposed Action** would lead to the restoration and revegetation of about 715 acres (FERC, p. 4-123). These areas would return to native plant communities similar to those that existed prior to dam construction. Natural, early successional forests would return quickly, with mature forests taking several hundred years to return. Most upland stands would be dominated by western hemlock and Douglas-fir, while riparian stands would contain red alder, bigleaf maple, black cottonwood, grand fir and willow. Establishment of non-native plants might be an initial concern at some sites, and mitigating measures to control these species would be identified in the Implementation EIS.

Removal of the dams would eliminate or degrade 43 acres of existing wetlands, but reestablish 48 acres of recovered wetlands in either palustrine forest or palustrine shrub communities (FERC, p. 4-125). An additional 122 acres of wet channel/river and gravel bar wetlands would be created.

Cumulative Impacts to Vegetation

Filling of the reservoirs destroyed more than five linear miles of low elevation (less than 600 feet) riparian communities. Most low-elevation riparian communities on the Olympic peninsula have been impacted through the removal of natural forest vegetation. Most areas are in various stages of forest regrowth, but remain in active logging rotations. With the exception of some of the west side rivers, no low elevation riparian areas on the peninsula are managed for natural conditions and long term protection. Recovered river bottom lands in Lake Mills and Lake Aldwell would be managed for long term protection under the **Proposed Action**.

Conclusions

If **No Action** is taken, 715 acres of potential native forest and over five linear miles of low riparian and wetlands communities would continue to be inundated by the reservoirs. If the **Dam Retention** (with mitigation) alternative is selected, these lands could continue to be flooded, but 189 acres of vegetation around Lake Aldwell would be modified for wildlife mitigation. With **Removal of Elwha Dam**, 290 acres of land would be revegetated and 22 acres of wetlands recovered. With **Removal of Glines Canyon Dam**, 425 acres of terrestrial habitat and 26 acres of wetlands would be reclaimed. If the **Proposed Action** is selected, 715 acres of habitat, including 48 acres of wetlands, would be restored. Draining



the reservoirs would eliminate 43 acres of wetlands. An additional 122 acres of wet channel and gravel bar wetlands would be created if the dams were removed.

Wildlife

Affected Environment

The Elwha area supports a variety of birds, large and small mammals, amphibians and reptiles. Large mammals include Roosevelt elk. Important elk calving areas occur at the mouth of Cat Creek, at the upstream end of Lake Mills, and near Altaire Campground, just below Glines Canyon Dam (Elwha Report, p. 19). Small mammals include beaver, mink, river otter, and pine marten. Birds include numerous passerines, waterfowl, raptors, and marine species. In the upper Elwha, populations of fish-eating (or carcass-eating) wildlife species probably decreased when salmon and trout were blocked by the dams. At least 22 species feed in whole or in part on salmon or their carcasses, including black bear, bald eagle, mink, river otter, Pacific fisher, pine marten, long-tailed weasel, belted kingfisher, and common merganser.

On Lake Aldwell, a wintering population of trumpeter swans is of local concern. These swans, which are also known to use Lake Mills, have recently numbered up to 60 (letter from L. Gillette M. Jordan, The Trumpeter Swan Society, Maple Plain, Minnesota, May 14, 1994). They are part of the Pacific Coast population, currently numbering about 14,000 birds, with 2,000 wintering in western Washington. They use a variety of habitat types including agricultural fields, forested wetlands, ponds, lakes, and estuaries.

Impacts to Wildlife

Under the **No Action** alternative, a total of 715 acres of terrestrial wildlife habitat would remain unavailable due to inundation or facility use and important bottomland riparian habitat would continue to be unavailable for winter elk use. No wildlife mitigation would occur under this alternative. In the upper and middle drainage, up to 22 wildlife species which use salmon as food would continue to be adversely impacted. Swans and other waterfowl would continue to use the reservoirs as winter habitat.

Dam Retention

Dam Retention (with mitigation) would be the same as the **No Action** alternative except that 189 acres of lands around Lake Aldwell would be managed to benefit wildlife species, and the partial restoration of salmon runs would benefit wildlife species which feed on salmon carcasses, live fish, or fish eggs. (Elwha Report, p. 59; FERC, p. 4-47).



Impacts from either the **Removal of Glines Canyon Dam** or **Removal of Elwha Dam** would be similar. Removing Elwha Dam would result in the eventual restoration of 290 acres under Lake Aldwell, while removing Glines Canyon Dam would mean the restoration of 425 acres under Lake Mills. These areas include bottomland riparian vegetation, important as winter elk range. Both alternatives would likely restore some salmon stocks, with expected restoration more beneficial to wildlife species which use carcasses, live fish or eggs if Glines Canyon Dam is removed. Under both alternatives, 189 acres near Lake Aldwell would be managed to benefit wildlife. Swans would continue to use Lake Aldwell as winter habitat if Glines Canyon Dam is removed, but would lose this habitat if Elwha Dam were removed. (FERC, pp. 4-167 and 4-196).

FERC used a habitat evaluation procedure to model habitat changes for nine representative species: elk, deer, mink, beaver, Douglas squirrel, Cooper's hawk, lesser scaup, pileated woodpecker, and yellow warbler. In a study area which included the reservoirs and some surrounding lands, net increases in habitat would occur for all species except the lesser scaup under the **Proposed Action** (FERC, p. 4-131). In general species which prefer lake habitat such as scaups and some other waterfowl, would be negatively affected, while species that prefer river, riparian and upland habitats would be positively affected.

Restoration of native anadromous fish runs and the subsequent availability of salmon as prey in the middle and upper Elwha would benefit at least 22 wildlife species known to use this food source (Elwha Report, p. 59). Total biomass from returning salmon would increase about 12 times over existing conditions (FERC, p. 4-135).

Although the Pacific Coast population of trumpeter swans is relatively healthy, their primary limiting factor is continued loss of winter habitat. In dam removal alternatives, the birds wintering on Lake Aldwell would be displaced. Mitigating measures to minimize impacts to swans will be examined in the Implementation EIS.

Cumulative Impacts to Wildlife

Based on habitat modeling, existing elk winter forage in the project vicinity is limiting, and habitat quality is low (FERC, p. 3-53). Subpopulations are considered vulnerable due to their low numbers and to increasing development on winter range adjoining the national park. In the reservoir areas, short term recovery of grazing habitat and long term recovery of mature forest stands for thermal cover (an essential component of winter habitat) would benefit the local elk subpopulation. Wildlife species in the vicinity of the northern park boundary would be increasingly be impacted through the conversion of lands from natural conditions to active human activities. The revegetation and long term protective management of 416 acres at Lake Mills within Olympic National Park would benefit many wildlife species.



Conclusions

Wildlife would benefit from the revegetation of reservoir lands and introduction of fish biomass into the Elwha River ecosystem. The **Proposed Action** would create the greatest number of acres and restore the highest biomass levels of fish, and so would have the greatest positive impact on wildlife of all the alternatives. To a lesser extent, and in descending order, natural systems would benefit from the **Removal of Glines Canyon Dam, Removal of Elwha Dam, and Dam Retention** (with mitigation) would most benefit wildlife.

Species of Special Concern

Affected Environment

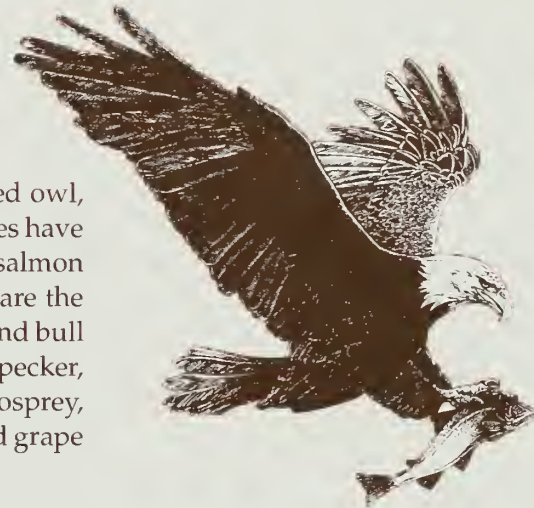
Four federally threatened species live in the area -- the northern spotted owl, marbled murrelet, bald eagle, and Steller sea lion. Three additional species have been petitioned for federal listing, the Elwha pink salmon, coastal coho salmon and coastal steelhead. Species which are candidates for federal listing are the Pacific fisher, harlequin duck, northern goshawk, Cotton's milk-vetch and bull trout. Species which are candidates for state listing are the pileated woodpecker, common loon, and Vaux's swift. State monitor species in the area are osprey, great blue heron, barred owl, turkey vulture, Pacific harbor seal, orca and grape fern (Elwha Report, p. 19; WDFW 1993; FERC, p. 3-60).

Five sensitive plant species may occur in the area (FERC, p. 3-63): porcupine sedge, tall bugbane, giant helleborine, water lobelia and branching montia. Surveys conducted in July and August, 1990 located nine giant helleborine plants between the road to Whiskey Bend and the bypass reach in the area of Glines Canyon Dam (FERC, p. 3-64). Additionally, there are 14 plant species reported to occur in the Elwha Valley considered rare or extremely rare within Olympic National Park boundaries (C. Hoffman, personal communication, August, 1994).

Northern spotted owl surveys have found seven pairs between the Elwha headwaters and the national park boundary (FERC 3-59), two active nests were located within 2.2 miles of the river and Lake Mills, and at least one additional nest between U.S. Highway 101 and Lake Aldwell (USFS, personal communication, June 1994).

Bald eagles are observed year-round in the area, and two nest sites occur just east of the mouth of the river (FERC, p. 3-58). Eagle densities generally decrease moving away from the sea. Prey are primarily marine birds, Chinook salmon carcasses in the lower river, resident fish in the reservoirs, and carrion, particularly elk and heron.

Marbled murrelets are primarily marine birds although they nest in semi-colonial aggregates in inland, old-growth forest stands (Federal Register 1992) and feed on fish and invertebrates in near-shore marine waters. Murrelets



surveyed from March through September, 1990, were estimated at 15 pairs in the upper Elwha River valley or tributaries during the breeding season (FERC, p. 3-59). From Krause Bottom above Lake Mills, to the river mouth, the river appears to be used primarily as a travel corridor, with little nesting along the path. However, there were possible nest sites in stands along Boulder, Cat, and Stukey Creeks, and above Altaire Campground. No murrelets were observed on either reservoir.

Impacts

In the short term, removal of the dams and related activities have the potential to impact federally listed species. It is anticipated that potential impacts could be avoided through timing restrictions and by routing access roads to avoid nest sites. A biological assessment will be written which addresses the preferred alternative described in the Implementation EIS. This will then be used as the basis for determining whether formal consultation is required with the U.S. Fish and Wildlife Service.

In the long term, forest maturation in the reservoir areas would have a beneficial affect on northern spotted owls and marbled murrelets, and the renewed availability of salmon carcasses is expected to increase the number of wintering bald eagles along the middle sections of the river. Steller sea lions could also benefit from increased numbers of ocean-running salmon.

Both the **No Action** and the **Dam Retention** (with mitigation) alternatives would exert an ongoing negative impact on several federally listed species through removal or inundation of habitat, and a dramatic reduction in salmon and trout as prey. Steller sea lions and bald eagles both eat salmon, and spotted owls and marbled murrelets use mature forests for nesting. steelhead, coho salmon and pink salmon are all directly affected by the loss of habitat resulting from the dams.

Although **Removal of Glines Canyon Dam**, **Removal of Elwha Dam**, or the **Proposed Action** would improve conditions for these species, these alternatives would not restore the fishery or habitat to pre-dam conditions, thus sustaining some negative impacts on these species. (Elwha Report, pp. 47 and 51; FERC, pp. 4-172 and 4-200).

Cumulative Impacts

Spotted owls and marbled murrelets have been impacted primarily through the logging of old-growth and mature forest communities. The consequence of continued logging activity in their habitat is currently an issue of local, regional, and national debate (USFS and BLM, 1994). Bald eagle populations have shown a recovery from their lowest levels in the 1970's, and been upgraded from endangered to threatened species status.

Conclusions

Without carefully planned restrictions and avoidance measures, construction associated with removing the projects has the potential to adversely affect federally listed species. These measures will be developed through consultation with the U.S. Fish and Wildlife Service and addressed in the Implementation EIS. In the long term, the **Proposed Action** would improve conditions for spotted owls, marbled murrelets, bald eagles and Steller sea lions. Spotted owls and marbled murrelets would benefit from the restoration of forest habitat, and eagles and sea lions from the restoration of native anadromous fish as prey. Steelhead, and coho and pink salmon would benefit directly from the recovery of riverine habitat. All other alternatives would continue to exert negative impacts on these species, with **No Action** the extreme in terms of impacts through habitat inundation or inaccessibility, and the destruction of the salmon runs as a source of prey. The **Dam Retention** (with mitigation) alternative would restore a limited number of salmon and trout whose food contribution would benefit federally listed species. Single dam removal alternatives are slightly better, with the **Removal of Glines Dam** restoring more fish and more upland habitat than the **Removal of Elwha Dam**.

Cultural Resources

Affected Environment

Ongoing research has revealed the presence of many more resources within the project area than described (P. Gleeson, Olympic National Park, personal communication, August, 1994) by either the FERC EIS or Elwha Report. Cultural resources include structures, landscapes, traditional cultural properties and archeological sites.

The Elwha River Valley is rich in cultural resources with a history of human occupation dating from prehistoric times when people settled in the valley, drawn to the river which provided food, water, and served as an important transportation corridor.

Ethnographic research indicates a long history of Elwha S'Klallam settlements along the Elwha River and the coastal portion of the project area. The Elwha River has been central to the culture of the S'Klallam Tribe who have lived and utilized the river basin not only for the resources and sustenance, but as the heart of the tribe's spiritual existence. Construction of Glines and Elwha dams and subsequent loss of the Elwha as a free flowing river cuts to the core of tribal spiritualism, destroying the fish so vital to ceremony and economy. The reservoirs have flooded villages, fish camps, medicinal plant and food gathering and preparation sites, burial sites, and many important spiritual sites.

In the Elwha valley, there are many places which are of special significance to the S'Klallam, although some of these places have been inundated or made



inaccessible by the reservoirs. A "Cleansing Site," where tribal members went to purify themselves and receive spiritual guidance is underwater, as is the "Creation Site" where the S'Klallam Tribe first formed. Ironically, just above the Elwha Dam, in a location formerly pristine, is the "Prophecy Hole," where the S'Klallam people would go to receive guidance and envision their future (Elwha Report, Appendix L).

Euro-Americans began settlements on the river in the late 19th and early 20th centuries. As their S'Klallam predecessors, these settlers were drawn to the river so bountiful with resources. In the 1860's several S'Klallam families established Western-style homesteads and farms in the lower Elwha valley. The dams were constructed in the first two decades of the 20th century to harness the power of

the river and provide it for local consumers in Port Angeles. S'Klallam homesteaders lost farms, homes and stock when the Elwha Dam failed during construction in 1912.

A continuous history of human occupation in the Elwha Valley has not been well-documented, although efforts to inventory resources within the area of potential effect are on-going. The documentation of archeological resources has been made difficult by the dynamic nature of the river itself, poor ground visibility, and flooding of areas following dam construction. Historically important structures include the home sites, Elwha Ranger Station, Elwha and Altaire Campgrounds, the one-lane Elwha River Bridge, and the two dam complexes. Both projects are listed in the National Register of Historic Places. Elwha River Hydroelectric Power Plant Historic District includes the dam and both spillways, the five penstocks, and powerhouse; the Glines Canyon Hydroelectric Historic District includes the dam and spillway, intake, gate house, and surge tank.



Glines Canyon Dam spillway, no date. (Clallam County Historical Society)

Impacts

Under the **No Action** alternative, no changes would occur in the Elwha River Hydroelectric Power Plant Historic District, Glines Canyon Hydroelectric Historic District, or other historic sites. Members of the S'Klallam Tribe would continue to suffer the loss of important tribal resources integral to their traditions and their culture, and sacred land would remain inundated or inaccessible through continued damming of the Elwha River. Fluctuations in lake level could also result in the further erosion of archeological sites.

Under the **Dam Retention** (with mitigation) alternative, both dams would be modified: the Elwha Dam with a fish ladder and Glines Canyon with the addition of trap-and-haul facilities. These actions are compatible with existing hydroelectric use, but introduce new elements which could affect the very qualities that constitute the dams eligibility for a listing on the National Register in the first place. Fish ladders would improve survival rates for some stocks, but not sufficiently to provide substantial fish harvests for tribal members, commercial fishers or recreationists. Access to inundated traditional use and spiritual sites would continue to be denied.

Removal of Elwha Dam would result in the loss of a property listed in the National Register of Historic Places, which is "a historically significant example of a low head hydroelectric system in Washington State from the early 20th century. The dam is a rare, early example of the multiple-buttress type. The blowout and reconstruction of the original dam foundation is noteworthy because it represents a failure of early engineering and a successful response to that failure" (Elwha Report, Appendix L).

Removal of Glines Canyon Dam would eliminate a project historically important because of "its association with the evolution of power plant design and contribution to the development of the automation of hydroelectric installation....It marks the closing of an era which characterized early hydroelectric development within the state."

The Washington State Office of Archeology and Historic Preservation would play an integral part in preserving the history of the dams and associated project facilities should any or all be removed. Any mitigation would include complete documentation of the projects according to the standards of the Historic American Engineering Record. Such documentation would include a history of each project, measured drawings of designated features, and photographs and archival copies of important engineering records and drawings. Other mitigation measures could include onsite interpretation of remaining features of the projects and the removal process (Elwha Report, Appendix J).

Cultural or archeological sites in the immediate vicinity could be uncovered or damaged by construction activity during removal of either or both dams. To

identify and avoid areas where cultural sites are present, a survey would be conducted prior to construction activity. Whenever possible, construction activity would be routed to avoid sensitive areas and rerouted if unexpected sites are uncovered during construction. DOI would consult with the State Historic Preservation Officer and Advisory Council of Historic Preservation to determine the best mitigation tactics. A programmatic agreement between federal and state agencies with responsibility for protecting cultural resources has been drafted to ensure cooperative action in managing cultural resources. The Elwha Ranger Station Historic District and the one-lane Elwha River Bridge may be affected if flooding increases in this section of the river as a result of dam removal.

Since traditional tribal sites important to the S'Klallam people lie beneath the dams, removing the dams and flushing the sediment might uncover some of these sites and return them to the tribe.

Sites now eroding because of a lack of sediment to protect them would be buried and protected if the dams were removed and sediment allowed to flow downstream naturally.

The **Dam Removal** (with mitigation) alternative would affect present-day cultural resources by reestablishing the native anadromous fisheries, thereby returning a traditional economic and cultural element to the tribe. The S'Klallam people would benefit from long-term restoration of ceremonial, subsistence, and commercial fishing. Traditional fishing sites would again be accessible, eliminating crowding with non-tribal fishers at the mouth of the river. Shellfish habitat at the river mouth would be replenished as sand and upstream nutrients were carried to the sea. Restoring the free-flowing river and native anadromous fisheries would have positive impacts on the material and cultural well-being of tribal members and could eventually revitalize the S'Klallam Tribe and their culture (Elwha Report, p. 44).

The free-flowing river may meander across a wider piece of the floodplain along the Elwha River causing localized flooding and damage to historic sites from water and sediment deposits. The Elwha Ranger Station Historic District and Elwha River Bridge are both recognized historic sites downstream of the dams. Others may exist, and an inventory to identify them is presently underway. Archeological resources such as villages or seasonal camps would likely be located in safer areas outside the floodplain, and so are not expected to be affected by dam removal. Also, because the pre-dam river changed course frequently, it may have already eroded less permanent or protected sites (Elwha Report, Appendix L).

Cumulative Impacts

A number of cultural resources on the Olympic Peninsula have been lost in the past. Removal of the Elwha and Glines Canyon Dams might result in some additional property loss. Documenting these resources before major changes are made would contribute to the future preservation of their historical significance.

In the late 19th and early 20th centuries, a number of events occurred to adversely affect the cultural fabric of the S'Klallam Tribe: boarding schools discouraged or banned use of the native language; Indian agents prohibited traditional religious practices; and logging and development affected the streams by increasing sediment and damaging the salmon runs. Efforts to affect positive change through removal of the dams would allow tribal members to return to traditional ways and restore their spiritual relationship with the river.



Fishing the Elwha in the 1920's. (Asahel Curtis photo, Washington State Historical Society)

Conclusions

The free-flowing Elwha River and native salmon fisheries are central to the culture of the Lower Elwha S'Klallam Tribe. Benefits to the tribe would increase in direct proportion to the degree of restoration of the river and native fisheries. Only the **Proposed Action** would restore the river and fully reestablish the native fisheries lost almost a century ago. Removing either dam or installing fish passage measures would only partially restore the fisheries, but sacred sites would remain buried beneath the Elwha project and Lake Aldwell, and possibly under the Glines Canyon project and Lake Mills as well.

Conversely, the dams are historically significant as examples of early hydroelectric systems. Although their features would be inventoried, photographed and recorded, the dams and powerplants would be lost if the **Proposed Action** is implemented. This is true of the single dam removal alternatives as well.

Recreation, Esthetics and Land Use

Affected Environment

The Elwha River valley is mostly used for hiking, fishing, camping, horseback riding and boating. Less frequently, people visit the area to sight-see, picnic, observe wildlife or hunt.

Certain parts of the valley have limited road access, and none are as easy to reach as more developed regional sites (FERC, pp. 3-78 to 3-79). There are a few places where visitors can have river access or reach the reservoirs by road. Above Lake Mills the river is accessible only by trail and the shoreline is inaccessible in several areas due to steep banks and deep gorges (FERC 3-80). All of the river valley upstream of mile 9.5 lies within Olympic National Park, a part of the park called the Elwha subdistrict, that is used relatively little because of its proximity to the neighboring Hurricane subdistrict and more famous Lake Crescent subdistrict. Even so, an average of 700-900 people raft parts of the river each year (FERC, p. 3-83); an estimated 5,000-8,000 people stay in two park campgrounds on the Elwha River; there is some sports fishing, and several thousand people use the Elwha subdistrict backcountry for hiking.

The Washington Department of Fisheries and Wildlife (WDFW) grants permits for fishing on the Elwha River below the Elwha Dam, and report angler catches of 127-157 summer steelhead per year (1987-89), and 1,000-2,300 winter steelhead during the same years. A small WDFW ramp on Lake Aldwell is accessible from U.S. Highway 101 and provides a place for canoes or other small boats to launch and take advantage of fly fishing along the eastern shoreline and north end of the lake. A second boat ramp on Lake Mills owned by James River Paper is used as a site to launch small boats and canoes. From July to September in



1981 and 1982, anglers spent 8,500-9,500 hours fishing both lakes (FERC, p. 3-83). In combination with the middle stretch of the Elwha, anglers spent an average of 22,000 hours per summer fishing primarily for rainbow trout (FERC, p. 3-44)

Marine recreational fishing is considered excellent in the Strait of Juan de Fuca, where Chinook salmon, coho and pink salmon are taken just offshore of Ediz Hook during the late summer months (FERC, 3-82) and several fishing charters are available from Port Angeles (for further information on marine fishing for salmon and trout in the area, see Elwha Report, pp. 16-17, and the "cumulative impact" write-up in the fisheries section of this document).

Nine trailheads in the Elwha drainage basin provide access to approximately 20 backcountry trails. Five of the nine trailheads also allow access to day hike trails of up to three miles. Neither the Park nor WDFW has kept attendance records in the area for day hikes, but between 8,000 and 14,000 visitors annually camped overnight in the backcountry from 1985 to 1989 (FERC, p. 3-83).

There are no formal viewing spots of the Elwha River from the highway or road, though some informal viewing spots are on pedestrian crossings where visitors can see the river or reservoirs from the road (FERC, pp. 3-87 to 91).

Within the park and upstream of Lake Mills, the Elwha River is in pristine condition and is considered eligible for designation as a wild and scenic river. Water quality, fish habitat, riparian habitat and scenic and esthetic values are as they were when the first European settlers arrived. Here the river valley retains its character as a lush rainforest.

Outside the park boundary, some of the forest adjacent to the river has been logged and developed into homesites and farms. The middle and lower sections of river land are a patchwork of public land (US Forest Service, Washington Departments of Natural Resources and Wildlife) and private land (including 422 acres of tribal land at the mouth of the river). Some of these lands have been and will continue to be logged. Pieces of land between the reservoirs are used for transmission lines, support for the power production of the dams, municipal and industrial water intake, and state and tribal fish hatcheries.

Relevant plans or policy statements for the management of these lands and river resources have been prepared by Olympic National Park, National Marine Fisheries Service, Pacific Fishery Management Council and Clallam County, as well as other governing agencies including the Lower Elwha S'Klallam Tribe Point-No Point Treaty, Northwest Conservation Council, and Washington Department of Fisheries and Wildlife. Many of these plans and policies address the restoration of the native anadromous fisheries. Others deal with managing coastal, recreation and wildlife resources. Pages 3-64 and 3-68 to 3-77 of the FERC Draft Staff Report has more detailed information on each of these plans.



Impacts

Recreational Fishing. Under the **No Action** alternative, the impacts to recreation are primarily on sports fishing, both in the river and the marine environment. The Elwha River was historically noted to be one of the largest producers of salmon and steelhead on the Olympic Peninsula, yet current runs are only a small portion of their former size. In part, this is because the dams block upstream migration of fish and downstream flow of spawning gravels and nutrients. The reservoirs have inundated more than five miles of important riverine habitat, and releases from the reservoirs result in water temperatures 2° to 4° C. higher than normal. These conditions have reduced the number of harvestable salmon for recreationists both in the Elwha River and marine environment. Presently, in-river fishing opportunities for native anadromous species are limited for sports fishers to a 100-400 fish summer steelhead fishery.



River anglers catch primarily rainbow trout or native char in the mid and upper Elwha River or in the two reservoirs (see previous “Affected Environment” section).

In the short term, removing either dam could affect river fishing because of the initial need to protect native populations as they reestablish and rebuild. This could curtail recreational fishing for several years. In the long term, however, each of the action alternatives evaluated in the FERC EIS would help restore the salmonid fishery in the Elwha, with success dependent on the chosen alternative (see “Native Anadromous and Resident Fisheries” section of this document, or Elwha Report p. 35).

Reintroduced salmon and species of native anadromous trout would likely compete with resident trout and native char for food and habitat, lowering the numbers of these resident fish. All dam removal alternatives would result in more fishing opportunities, but the FERC EIS predicts a slight overall decrease in fish available to anglers if both dams are retained, with fish passage measures installed and hatchery operations phased out (See “...Fisheries” section of this document and FERC, p. 4-68).

If **Dam Retention** (with mitigation) and fish passage measures were installed, coho, winter and summer steelhead runs of salmon and trout have a fair chance of restoration, but none have “good” or “excellent” chances for restoration.

Removal of Elwha Dam would eliminate the most imposing passage problems for pink and chum salmon, and completely eliminate passage problems for sockeye salmon. Coho and steelhead would have a “fair” chance for restoration, but pink, chum, Chinook and sockeye are anticipated to have a “poor” or “poor to fair” chance. The natural balance from a reintroduction of native anadromous salmonids would most likely reduce populations of resident trout and char.

Removal of Glines Canyon Dam would raise the probability of restoration for steelhead from “fair” to “good”, and for Chinook and coho to “fair” or “good”. With the Elwha Dam still in place, however, sockeye, pink and chum all fare worse, their chances for restoration dropping to “none” or “poor”. Resident trout and char populations would also grow smaller.

Removal of both dams would eliminate passage problems for all native Elwha native anadromous fish, and would fully restore habitat for all except sockeye salmon. The Elwha sockeye require a freshwater lake for their life cycle and depend on the highly developed Lake Sutherland. Restoring river habitat would not repair the condition of Lake Sutherland, reducing all sockeye runs from “good” or “excellent” chances for restoration to a “poor to fair” chance. Like all other alternatives which reintroduce native anadromous fish, the **Proposed Action** would also result in a population reduction of resident trout and char.

Camping, Hiking and Whitewater Rafting. All dam removal alternatives involve the loss of at least one reservoir and all recreation associated with it, including boating, camping, fishing and viewing. All action alternatives have a short term impact on recreation directly and indirectly through road and campground closures due to noise, dust, in-stream sediment and the general loss of a quiet, natural environment.

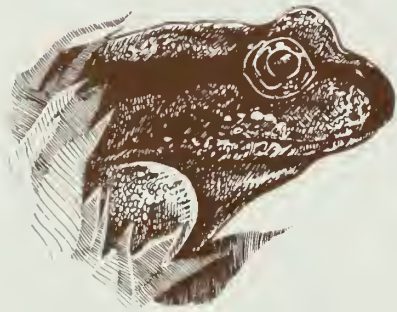
In the long term, each removal alternative creates new recreation opportunities for anglers, whitewater rafters and visitors seeking a natural, high-quality riparian experience. If both dams are removed, 5.3 stream miles would be added to the Elwha. If only the Glines Canyon Dam is removed, 2.5 miles would be added, and 2.8 miles of additional river if only Elwha Dam is removed.

The present owner of the dams, James River Paper, has proposed three boat-in campsites, trails and an overlook at Lake Aldwell, and improvements to the boat launch facility at Lake Mills. These would increase reservoir recreational opportunities if either or both of the dams were retained, but under the present planning proposal, would conflict with Olympic National Park policy.

In the short term, all action alternatives involve construction, and the accompanying noise, dust, sediment, road closures and general disruption. Installing mitigation measures on each dam could last one to two years, and removing both dams could take up to four years.

Removing the dams and draining the reservoirs would also leave uncovered trees and stumps, as well as hundreds of acres of barren unvegetated land (415 acres under Lake Mills and 267 acres under Lake Aldwell; FERC, pp. 4-177 and 4-207). Revegetation would take place within three years, and the scene would naturally evolve into a varied landscape with multiple terraces. Roosevelt elk might graze these open areas providing wildlife viewing opportunities for visitors.

In the long term, each removal alternative creates new recreation opportunities ...



Land Uses. Lands inside park boundaries acquired by the NPS, specifically those behind Glines Canyon Dam, would be managed according to Olympic National Park policies (Elwha Report, pp. 117-120, Appendix I). These policies include restoring, "...natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species," (NPS Management Policies, 1988) and "...conserve maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail were it not for the advent of modern civilization" (ONP Statement for Management, 1989).

The Lower S'Klallam Tribe is interested in trust ownership of land currently beneath Lake Aldwell. Some of this reclaimed land could be used for housing and economic development by the tribe. If the secretary of the interior chooses to remove both dams, DOI would examine different land disposal options for any acquired lands outside the park boundaries. Acquired river banks within project boundaries would be managed according to the standards in the Wild and Scenic Rivers Act (as required by the Elwha Restoration Act).

Solid waste would be produced by any dam removal alternative. If disposed of on land, three acres is the estimated area necessary to dispose of rubble from the Glines Canyon Dam, and an estimated 33 acres would be required for rubble from the Elwha Dam. A possible disposal site for the rubble was examined in the FERC EIS, but alternative sites and options for using the concrete (including ocean disposal and the creation of artificial reefs) will be examined in the Implementation EIS.

The **No Action** alternative would not generate solid waste, but would be inconsistent with all relevant agency-produced plans, including National Park Service and Olympic Park management plans and policies, the Fishery Management Plan (National Marine Fisheries Service and Pacific Fishery Management Council, 1989), and Clallam County Comprehensive Plan.

The present National Park Service policy to restore "natural aquatic habitats and the natural abundance and distribution of native aquatic species, including fish, together with the associated terrestrial habitats and species," and Olympic National Park's policy "conserve, maintain, and restore, where possible, the primary natural resources of the park and those ecological relationships and processes that would prevail if not for the advent of modern civilization" would both be in conflict with any decision which does not fully restore the Elwha River ecosystem. Since the **Proposed Action** is the only alternative which would accomplish this goal, it is the only alternative consistent with these policies. **Removal of Glines Canyon Dam** would restore only those natural ecosystem processes in the park and it could not restore native anadromous fisheries and wildlife to pre-dam conditions.

The Fishery Management Plan sets objectives for habitat preservation, production levels and escapement of each salmon species for the Pacific Coast. In Puget Sound rivers, the plan promotes the restoration and natural production of species, particularly coho and Chinook, to optimum levels. None of the alternatives except the **Proposed Action** could fully accomplish this objective; indeed the **No Action** alternative is inconsistent with it. To the extent that partial restoration of the fisheries occurs, each of the other action alternatives: **Removal of Elwha Dam**, **Removal of Glines Canyon Dam**, **Dam Retention** (with mitigation) would be somewhat consistent with Fishery Management Plan's policies.

Clallam County Comprehensive Plan places the importance on protecting and enhancing recreational resources which attract visitors to the area and support the local economy (FERC 3-76). Although the **No Action** and **Dam Retention** (with mitigation) options would continue to provide some recreation through the reservoirs, those alternatives which enhance ocean or river salmon and trout populations would also attract sports fishers and visitors into the area. The fish passage alternative would result in fewer salmon and trout than presently populate the Elwha River, and so is largely inconsistent with the county plan. **No Action** exerts an ongoing negative impact on native anadromous salmon and trout, and recreational fishing by restricting habitat to the lower 4.9 miles of the Elwha River; this alternative is also inconsistent with the stated priorities of the county plan. Single dam removal alternatives would partially restore the fisheries and hence attract fishing-related visitors, but only the **Proposed Action** would completely restore the fisheries fulfilling the intent as well as the objectives of the plan.

Cumulative Impacts

The Olympic Peninsula has many recreation areas (FERC, p. 3-79) managed by government agencies and private landowners. Olympic National Park has about 1,000 developed campsites and the surrounding Olympic National Forest has an additional 379.

Fishing for salmon, steelhead and other trout occurs in other peninsula rivers besides the Elwha (FERC, p. 3-78) and whitewater rafting on four rivers besides the Elwha. Two lakes, Lake Sutherland and Lake Crescent, exist within a few miles of the Elwha.

Construction associated with all alternatives except **No Action** may temporarily restrict access for hikers, campers and anglers in the Elwha subdistrict of Olympic National Park. This would likely create more crowded conditions at neighboring campgrounds, lakes, rivers, or on hiking trails. Although camping, hiking and fishing are available in the nearby Hurricane and Soleduck subdistricts of the Park, whitewater rafters would have to travel over 75 miles to find comparable stretches of river.



If native anadromous fish are restored to the Elwha through any of the dam removal scenarios, there would be a ten to fourteen year decrease in fishing opportunities while the species recover, followed by a much better fishing future. This could gradually increase the number of visitors to the Elwha subdistrict and alleviate some summer crowding in other subdistricts, providing a wider range of fishing opportunities regionally.

Conclusions

The Elwha River basin provides hiking, camping, fishing and boating opportunities. Fishing is primarily for resident trout and steelhead, and occurs both in the river and from small boats on Lake Mills and Lake Aldwell. The land within Olympic National Park which lies in this basin is mostly a pristine wilderness which is less used by recreationists than other neighboring subdistricts. Removing the dams and allowing sediment to erode naturally could send fine-grained silt and clay into the river, reduce catchable fish for several years and uncover barren lands at the reservoir bottom. This alternative and the single dam removal alternatives would also result in periodic closures of the Elwha subdistrict during construction. In the long term, salmon and trout fisheries would be restored and available for river and marine recreational fishing and new stream miles would be added for whitewater rafters. The valley character would be consistent with a wilderness recreation experience.

Socioeconomics

DOI Methodology

DOI used different assumptions than did FERC in preparing its analysis of costs to Daishowa Mill to buy the 38 percent of the power currently supplied by the dams. Instead of assuming nominal costs, DOI followed the federal Office of Management and Budget recommendations to use "real" costs. This is because nominal costs are overly sensitive to assumptions regarding future prices of energy, and to inflation (OMB, 1992). Real costs have removed inflation, but do take into account cost differences between energy supply sources that may be required by the supplier over time (in this case, Bonneville Power Administration; BPA).

After consultation with BPA, DOI has assumed that replacement cost would follow real cost trends for natural gas, rather than coal, as did FERC (BPA, 1994).

Additional information on DOI's assumptions is available in a referenced document entitled "Discussion and Extended Analysis of Energy Portions" in the FERC Draft Staff Report on Glines Canyon and Elwha Hydroelectric Projects, Washington, P. Meyer, August 15, 1994 (Meyer, 1994a).

Although DOI includes project costs from the FERC EIS, FERC did not include many of the costs DOI believes would be part of any alternative, such as costs for studies, water quality protection, flood control measures, NEPA documentation, additional mitigation, sediment removal or management, or acquisition of the dams by DOI. Since the FERC EIS was consistent in not including these costs for any alternative, the numbers herein can be used to compare alternatives. However, DOI does not agree the absolute costs are valid. A more thorough look at costs for the **Proposed Action** is located in the Elwha Report, pp. 138-141; the report does not examine the costs of other alternatives.

Affected Environment

Clallam County is on Washington State's Olympic Peninsula. The county encompasses an area from just east of the city of Sequim westward along the Strait of Juan de Fuca to the most westerly point of land in the continental United States - Cape Flattery - and southward to include the town of Forks. Port Angeles is the largest city in Clallam County. The county also contains a major portion of Olympic National Park.

For much of its length, the Elwha River flows within the boundaries of the national park before emptying into the Strait of Juan de Fuca west of Port Angeles. The Elwha drainage area is an important part of the traditional territory of the Lower Elwha S'Klallam Tribe, whose reservation lies adjacent to the river mouth. In addition, three other treaty tribes: the Jamestown S'Klallam, the Makah, and the Quileute, have reservation lands in Clallam County.

The population of Clallam County was at 56,464 in the 1990 census. County population grew less than one percent per year through the 1980's (FERC EIS, p. 3-97), but is expected to grow steadily in the 1990's, reaching nearly 60,000 by the year 2000. Much of this growth is expected to come from retirees and those employed by the recreation, and tourism industries.

The major employers in Clallam County are government, forest-products industry (2,700 jobs; FERC EIS, p. 3-98), and the tourism industry which provides

Table 4. *Economic Data for the Lower Elwha S'Klallam Tribe, Clallam County, and Washington State.*

	Lower Elwha S'Klallam Tribe	Clallam County	Washington State
Per capita income	\$5,000	\$12,755	\$14,923
Percent in poverty	35%	9.5%	7.8%
Percent unemployed	35%	8.0%	5.7%

1,660 jobs, drawing \$68 million in annual income primarily from sports fishing and visitors to Olympic National Park. Traditionally, the county also has been home to many commercial fishers. The Daishowa Mill currently employs about 350 people, and the Elwha and Glines Canyon Dams require ten full-time employees.

Over the past decade, a decline in the forest harvest base and in salmon stocks have caused substantial unemployment and economic distress in the county. These economic difficulties have been moderated somewhat by growth in businesses catering to the recreation and tourism sector, and a growing retiree contingency in the county population. At present however, Clallam County economic circumstances are still more distressed than other counties in Washington State. The Lower Elwha S'Klallam Tribe of approximately 500 members is the most economically disadvantaged of identifiable groups within the county. The S'Klallam Tribe's poor economic condition is exacerbated by an almost total lack of economic resources from which to improve its material well-being. Fisheries have traditionally helped to provide a base, but the dramatic decline of fish stocks since the Elwha and Glines Canyon Dams were built has contributed to the present low level of economic returns for the tribe.

Hatchery operations have provided limited income to the tribe from Elwha River fisheries. About 20 percent of the total tribal fishing revenue comes from the Elwha River, and most of that is from the harvest of returning hatchery-produced coho salmon (FERC, p. 3-100). Approximately 60 percent of active tribal fishers in 1988 had gross fishing incomes below \$1,000.

Power production from the Glines Canyon and Elwha dams presently provide an annual average of 172 Gigawatt hours (Gwh) of electrical energy to Daishowa Mill in Port Angeles. This represents 38 percent of the mill's total annual energy consumption. In 1994, the two dams generated about \$231,000 in taxes to Clallam County (Clallam County Tax Assessor's Office, as communicated by P. Meyer, August, 1994).

Impacts

Under the **No Action** alternative, there would be little change in the economic circumstances of Clallam County whose population is expected to approach 60,000 by the year 2000. Higher than state-average unemployment and lower than state-average income would likely continue. Tribal unemployment rates would also continue to exceed those for the rest of the county, and tribal income would remain substantially lower.

The real cost of power to Daishowa Mill to continue its operation would be \$2.1 million per year in 1997 dollars (see Table 5).

If the dams are retained and mitigation measures installed, the value of the



mitigated dams would rise and tax revenue would increase as a result. The cost of power produced by the hydropower plants at each dam would also increase. It is estimated that mitigation measures described in the "Description of the Alternatives" chapter of this document could add \$17 to \$34 million to the cost of the projects (see FERC, p. 2-15 and Elwha Report, p. 31). Local tax revenue from the projects would more than double if the low end figures for fish passage measures is used.

The real cost of power to Daishowa Mill would rise to over \$6 million per year in the base year 1997, depending on the success of Eicher screens proposed for fish passage. If they are not successful, traditional screens or relocated intake structures would be required, which would be substantially more expensive.

This alternative, as is true of all action alternatives, would likely impose fishing restrictions on reintroduced salmon and trout to facilitate restoration. The **Dam Retention** scenario, however, would also result in lower than present catches in the long term. This is partly because hatchery operations would be eventually phased out to support the restoration of native stocks, and because native anadromous fish would compete with resident trout and char.

Construction of mitigation measures would increase employment by an estimated 32 person years (FERC, p. 4-70).

Table 5. *Estimated Total Annual Real Energy Cost for Replacement Power (172Gwh) for Daishowa Mill (\$ million per year in 1996 dollars)*

Alternative

A. Based on Local Cost of Purchased Power

	<u>1997</u>	<u>2000</u>	<u>2010</u>
1. No Action	2.1	2.1	2.1
2. Dam Retention	6.2	6.2	6.2
3. Remove Glines	8.4	8.5	8.4
4. Remove Elwha	5.6	5.7	5.6
5. Proposed Action	4.8	4.9	4.7

B. Based on Regional Avoided Cost of Purchased Power

	<u>1997</u>	<u>2000</u>	<u>2010</u>
1. No Action	2.1	21	21
2. Dam Retention	6.2	6.3	6.3
3. Remove Glines	9.1	9.2	10.1
4. Remove Elwha	6.1	6.3	6.9
5. Proposed Action	5.8	6.2	7.6

Removal of Glines Canyon Dam, while retaining Elwha Dam with fish passage mitigation, would provide short-term construction-related benefits to the Clallam County area. (172 person-years; FERC, p. 4-178). This alternative would restore some of the native fisheries, although short-term fishing restrictions and phased out hatchery operations could mean reduced catches of some runs, notably coho and steelhead (FERC, p. 4-178). Losses from fish passage measures at Elwha Dam, availability of native stock, condition of fish habitat downstream of Elwha Dam, and inundation of habitat from Lake Aldwell could prevent full restoration of native anadromous fish populations. Partial restoration of the fisheries would marginally improve economic conditions for tribal, commercial, and sport fishers however, and would also restore some nature-based recreation benefits to the area within Olympic National Park. Recreation on Lake Mills would be eliminated.

Removal of Glines Canyon Dam would increase the cost of replacement power to Daishowa \$8.4 million per year, a four-fold increase over current conditions. Total local tax revenues based on the value of the projects would increase, both from the increased value of the mitigated Elwha Dam and because revenue to the local power utility would increase from surcharges on replacement power. Over the longer term, there would also be slight increases in tax revenue from fish-related activities and businesses. This option would be more expensive than removing Elwha Dam, and would cost between \$66 and \$72 million in 1990 dollars depending on the effectiveness of low-cost Eicher screens (FERC, p. 2-27).

Removal of Elwha Dam and retaining and mitigating Glines Canyon Dam, would provide short term construction-related benefits (84 person years) to the Clallam County area. It would also provide slightly improved fishery benefits, as some runs of native pink, chum and summer/fall Chinook salmon would be partially restored. As with other action alternatives, imposed restrictions would limit catches.

This alternative would increase real power costs to Daishowa Mill to \$6.6 million in 1997 dollars. Local tax revenues based on the value of the projects would decline, but revenue to the local power utility would increase more than if only the Glines Canyon Dam were removed. FERC estimates that this option would cost \$40 million in 1990 dollars (FERC, p. 2-28), however, the addition of an Eicher screen or relocating the intake at Glines Canyon Dam would add between \$4 and \$10 million to the price.

The **Proposed Action** would substantially restore Elwha system fisheries over an estimated 20-year period. Although restrictions on catches would be imposed in the short term, the long term benefits of full restoration of fishery stocks is expected to provide substantial economic benefits to tribal and non-tribal and

commercial fishers, as well as to sport fisheries and fish processing sectors. The welfare of the Lower Elwha S'Klallam Tribe would experience the most complete gain.

Restoration of the Elwha River to a natural condition would stimulate nature-based recreation and tourism over the long-term, both separately and related to Olympic National Park. Over the long-term, economic stimulus in Clallam County from the natural restoration of the Elwha River is likely to exceed what a fisheries-only recovery could provide. Non-marketed benefits to people who associate value with river restoration activity, regardless of specific use-related benefits, would be greatest under this option, and reservoir specific recreation would likely be replaced with people who prefer a natural riverine experience.

Short term construction benefits to Clallam County would be greatest under this alternative. Although FERC estimates that 19 to 140 workers would be required at any given time, and 228 person-years needed overall, (FERC 4-148), a more recent examination predicts as many as 1542 person years might be required to complete the **Proposed Action** (Elwha Report, Tables 13-16 and P. Meyer, 1994b). Employment figures for other action alternatives may also be higher.

The **Proposed Action** would increase real power costs to Daishowa to an annual \$4.8 million in the 1997 base year. If BPA is able to continue providing replacement power to Daishowa at local preferred rates, the **Proposed Action** would be the least expensive of all action alternatives into the foreseeable future. If BPA bases its cost of replacement power on regional avoided costs, however, the **Proposed Action** would be least costly only until the year 2000 at which time the BPA predicts it would become more costly to provide new power sources for the entire region (see Table 5, part B).

Property taxes received by Clallam County related to dam structures would be eliminated, but revenue paid to the local power utility as surcharges on the replacement power would increase by 11 percent of the real cost of providing replacement power. Substantial tax revenues would accrue over the longer term due to expansions in fishery, recreation and tourism.

FERC estimates removal costs for both dams at \$76 million, though this figure does not include some of the related costs including studies, or acquisition and additional mitigation. The Elwha Report predicts the total removal costs to be between \$147 and \$307 million, depending on sediment management (Elwha Report, p. 134). The \$307 million figure assumes a scenario in which all stored sediment is removed before the dams are removed (the Elwha Report does not recommend this as an option). Since the Elwha Report was published, further analysis has shown the dams could be removed and all studies and mitigation funded for less than the \$147 million figure. These options will be explored and fully costed in the Implementation EIS.



Cumulative Impacts

With timber resources dwindling, and jobs connected with this industry disappearing, unemployment in logging areas like the Olympic Peninsula has had a direct impact on the S'Klallam Tribe and Clallam County economy. Removal of both dams would substantially change the negative economic trend, both in the short and long term.

Regional avoided energy costs are expected to increase slightly over the next 20 years; any of the action alternatives would make a marginal contribution.

The tribal fishery is also affected by fishing pressure along the coasts of Washington and British Columbia. Marine catches of Elwha River salmon are managed by several agencies, including the Fraser Panel of the Pacific Salmon Commission, the Pacific Fisheries Management Council, the Washington Departments of Fisheries and Wildlife and the Strait of Juan de Fuca tribes (Elwha Report, p. 15). Marine fishing pressure without these controls could have an adverse and additive affect on Elwha salmon and trout runs and any effort to restore them.

Conclusions

All alternatives except **No Action** require Daishowa Mill to absorb additional costs for the 38 percent of its power not supplied by the projects. The real cost of providing this power at local preferred customer rates in the 1997 base year is: **No Action**, \$2.1 million per year; **Dam Retention** (with mitigation), \$6.2 million per year; **Removal of Elwha Dam**, \$5.6 million per year; **Removal of Glines Canyon Dam**, \$8.4 million per year and **Proposed Action**, \$4.8 million per year.

Construction jobs for all action alternatives would increase with **Dam Retention** (with mitigation) requiring 32 person-years; **Removal of Glines Canyon Dam**, 172 person-years; **Removal of Elwha Dam**, 84 person-years; **Proposed Action**, 228 person-years (FERC) to more than 1500 person-years (P. Meyer, 1994b).

Benefits from fishery restoration would directly and indirectly accrue from action alternatives. Full restoration would only be possible under the **Proposed Action** alternative, with the single dam removal alternatives performing roughly equal and slightly better than the **Dam Retention** (with mitigation). Socioeconomic benefits to the Lower Elwha S'Klallam Tribe would be directly related to the degree to which the fisheries are restored.

FERC included cost estimates for each alternative in its EIS. The Elwha Report updated costs for **Removing Both Dams**, and included many items (such as for studies, dam acquisition, water quality protection and flood management) FERC either excluded or may have underestimated. The FERC estimates should be used for comparative purposes, rather than as accurate and absolute numbers.

FERC estimates **Dam Retention** with mitigation as proposed by DOI to cost between \$22 and \$40 million (with additional mitigation costed from the Elwha Report); **Removal of Glines Canyon Dam** and mitigating the Elwha Dam, between \$67 and \$76 million; **Removal of Elwha Dam** and mitigating Glines Canyon Dam, \$47 to \$53 million; and **Removing Both Dams**, \$76 million. The Elwha Report (p. 134) predicted the full costs of **Removing Both Dams** would be in the neighborhood of \$147 to \$203 million. These increases over what the FERC EIS reports for full dam removal would likely be true of other alternatives as well.

Safety

Dam Safety

Affected Environment

Both Glines Canyon Dam and Elwha Dam have undergone testing to measure their structural integrity under normal operating conditions. A procedural history of these tests and measures taken to improve safety of the dams is found in the FERC EIS, pp. 2-5 to 2-10.

Both are classified with a high hazard potential because of the potential for loss of life and significant property in the event of dam failure. Because of this, FERC has required additional measures to meet the probable maximum flood loading conditions. In November 1989, Glines Canyon Dam was modified through the addition of post-tension anchors.



*The first Elwha Dam near completion, circa 1911.
(Daishowa/James River Company Photo)*

The U.S. Army Corps of Engineers considered Elwha Dam potentially unsafe for floods greater than 40,000 cfs in 1978, and recommended a variety of measures to repair and strengthen it. FERC agreed, and in 1982 it required additional anchors in the north spillway and intake sections. Later, FERC required an updated emergency action plan (EAP) from James River II. Both were satisfactorily completed, although the EAP was accepted on an interim basis.

Impacts

Changes made to Glines Canyon Dam in 1969, 1977 and 1978, and 1989 have stabilized it and FERC now considers the dam to be able to withstand the probable maximum flood (PMF). The Washington State Department of Ecology Office of Dam Safety has indicated Glines Canyon Dam currently meets state safety standards for both PMFs and earthquakes (FERC, p. 2-5), and that Elwha Dam can withstand a PMF (FERC, p. 2-8). It is unknown whether Elwha Dam could withstand earthquakes in the immediate vicinity (M. Scuderi, U.S. Army Corps of Engineers, personal communication, August 1994).

Removing the Elwha Dam may cause safety problems if not handled properly, because the dam failed in 1912 while it was being built. Although the spillways and power penstocks are supported by bedrock, the concrete gravity portion of the dam rests on sand and gravel. To ensure the dam would hold while it is being removed, the reservoir would be lowered and the dam taken out from the top down (Elwha Report, Appendix F).

Flooding

Affected Environment

Average annual discharge from the Elwha River is about 1500 cubic feet per second (U.S. Army Corps of Engineers, 1994). Flooding can occur during winter and spring, particularly from October through March. Flood discharges have ranged from 4,680 cfs in 1936, to 41,600 cfs in 1897. The greatest recorded discharge in recent years was 28,700 cfs in 1990 (J. L. Lencioni, U.S. Army COE, personal communication, August, 1994).

A frequency analysis of yearly peak discharges shows a flood of 5,000 cfs has a 97 percent chance of returning each year; a 13,000 cfs flood has a 50 percent chance of returning each year. The highest measured flood of 41,600 cfs has a 71-year return period, or a 1.4 percent chance of returning each year.

Impacts

The greatest impact of dam removal on flooding results from the release of deposited sediment and reintroduction of natural sediments into the river channel downstream of the dam sites. This increase in bedload would cause

the river to rise, possibly resulting in localized flooding along the river including the industrial intake near the river's mouth.

The meandering nature of the river is also influenced indirectly by the dams. Because sand and gravel is trapped behind the dams, the streambed has become "armored" with larger cobbles. These larger rocks do not move as easily as sand and gravel and have resulted in a more stable channel than prior to dam construction.

With the dams in place, the river has been close to "run-of-the-river," i.e. regulated according to a natural, pre-dam flow regime. Flows, however, may be supplemented during late summer and early fall, and neither reservoir is operated for flood control purposes.

There would be little change over existing conditions with either the **Dam Retention** (with mitigation) or **Removal of Elwha Dam** alternatives. However, if the **Removal of Glines Canyon Dam** or **Proposed Action** alternatives are selected, the elevated riverbed and greater meandering could cause an increase in localized flooding.

Flooding could be mitigated through the modification of existing levees, construction of new levees, monitoring and dredging as needed, purchase of flood insurance, or other measures. If DOI chooses to remove the dams, these measures will be examined in detail in the Implementation EIS.



*Starting of construction
at the base of the Elwha
Dam, 1911.
(Daishowa/James River
Company Photo)*

Hazardous Materials

Affected Environment

A team of DOI agency experts composed of individuals from the Bureau of Reclamation and U.S. Fish and Wildlife Service, inspected both dams and accompanying facilities in May, 1994 for the presence of hazardous materials. Because the dams were built in the early 1900's, the team was particularly looking for asbestos in the building materials and polychlorinated biphenyls (PCBs) in the transformers.

Impacts

Team members found asbestos in the exterior siding of the Elwha Dam office, floor tile and interior wall plaster in the residence associated with Glines Canyon Dam, and throughout the insulation for electric cables within both powerhouses. (DOI, May 19, 1994, "Elwha Dam and Glines Canyon Dam Hazardous Waste Status")

Numerous samples of oil were taken from the Glines Canyon Switch Yard transformers and one sample of oil-soaked soil taken at the base of the power pole just outside the fence of the Elwha power pole storage yard, will be analyzed by October, 1994 to determine the presence of PCBs.

Removal of the dams, powerhouses and associated facilities may result in some asbestos or PCB-laden oil or transformers being transported offsite to a hazardous waste facility. There is some slight chance either asbestos or PCBs entering the river during dam removal.

Construction is required for all alternatives except **No Action**. Heavy equipment used for construction may leak oil, or require refueling at the site, and this too could result in minor amounts of oil or diesel fuel entering the reservoirs or water.

Cumulative Impacts

There is a natural danger of flooding to all who live in the Elwha River floodplain, even with both dams in place.

Conclusions

The Washington State Department of Ecology Office of Dam Safety has indicated Glines Canyon Dam currently meets state safety standards for both PMFs and earthquakes (FERC, p. 2-5), and that Elwha Dam can withstand a PMF (FERC, p. 2-8). It is unknown whether Elwha Dam could withstand earthquakes in the immediate vicinity (M. Scuderi, U.S. Army Corps of Engineers, personal communication, August 1994).

Proper safety precautions would be taken if the dams are removed. Removing Glines Canyon Dam or both dams would create a more free-flowing, dynamic river which would meander over a wider range and flood more frequently as the riverbed rises. Asbestos and possibly PCBs, both considered hazardous materials, are potentially present at both dam sites. These materials would be transported to a hazardous waste disposal facility if either dam is removed.

Elwha River Ecology

An area's ecology is composed of physical and biological pieces which interact and are mutually dependent upon one another. Fully restoring a natural ecology or an ecosystem begins with restoring the natural physical processes, which in the case of the Elwha River, means flow and transportation of sediments and organic material.

Affected Environment

Before the dams were built, the Elwha River looked different than it does today. In places where the river gradient was not as steep (much of the middle and lower river), the main channel was braided and meandering, forming side channels and pools. The riverbed was a mix of sand, gravel, cobbles and fine-grained sediments. The coarser grained material would move at high flows, and when it did, would have a scouring effect on vegetation attempting to sprout on in-river "islands" or bars of sediment. Water contained both particulate and large woody organic debris, and was cloudy during the rainy seasons. Much of the river and its tributaries upstream of the dams are still this way, but the 12 miles below Glines Canyon Dam are very different. The middle and lower stretches of the Elwha River are now largely devoid of smaller gravels and sand. The sediment which has washed down from the upper river and tributaries is trapped behind Glines Canyon Dam. A smaller portion lies behind Elwha Dam. Some debris and organic material is also blocked, with less flowing into the middle and lower river than pre-dam condition.

As sand and gravel have washed out, the elevation of the riverbed and of the river has dropped in many places. The riverbed is now "armored" with large cobbles which move downstream only under high flow conditions, and flow is more often contained within the channel boundaries (i.e. does not overtop the channel or flood at lower flows) with vegetation taking hold and maturing on gravel and sand beds as a result. The river is still turbid during the rainy season, as clay and much of the silt stays suspended in the water as it flows through the powerplants of each dam, and reservoir releases raise water temperatures by 2° to 4° C. in some seasons.

The dams have also eliminated more than five miles of riverine habitat through inundation by the reservoirs. Because the river is less active, fewer side pools or channels form and the estuary at the river's mouth is one-half mile narrower

than under pre-dam conditions.

To survive and breed successfully, the native anadromous salmon and trout, which used the Elwha River before the dams were built, require spawning gravels, nutrients, and organic debris. The side channels and pools are necessary for juveniles of some species to rear. In addition to keeping nutrients and spawning gravels away from the fish, the dams have blocked the possibility of access to the natural, high quality habitats which remained upriver. Neither dam was built with fish ladders or other means of passage, and the populations from all species of native anadromous fish have declined dramatically over the intervening 80 years as a result.



In the pre-dam Elwha, salmon and trout brought nutrients from the sea in the form of body weight or biomass all along the 45 miles of river. Most adult salmon die within days or weeks of spawning in the river; before the dams were built, carcasses of these fish fed at least 22 species of birds and mammals. The river was well-used by the 10 runs of native anadromous salmon and trout, and there was no month of the year when one or another was not migrating upstream, spawning, rearing, or passing juveniles out to sea (see Table 3, In-River Life Cycle Stages of Elwha Salmonids). The live fish and their carcasses provided food during late fall and winter, when food is scarce, as well as the rest of the year. (Elwha Report, p. 36).

In addition to feeding an abundance of wildlife species, native anadromous fish completed the cycle by returning important minerals and nutrients to the river. Two nutrients, phosphorus and nitrogen, often limit biological productivity in Northwest streams. Yet, decomposition of the salmon carcasses potentially provided over 13,000 pounds of these essential nutrients to the Elwha River under natural conditions. (Elwha Report, p. 36). The nutrients were absorbed by aquatic plants and animals, which formed the base for an in-stream food chain, and fed the juvenile salmon and trout.

Impacts

If **No Action** is taken, the dams would continue to block the downstream flow of organic material and sediment, as well as the upstream migration of salmon and trout. The entire river, except for the bottom 4.9 miles, would remain unnaturally low in fish biomass and populations of at least 22 species of wildlife would be smaller than the land can support unless the fish are reintroduced.

The stream ecology would remain unnatural as well, with armored and relatively immobile channels, and with limited nutrients to support aquatic productivity. Water temperatures would remain elevated, and hatchery fish, which make up the bulk of the spawning native anadromous fish in the Elwha River, would remain crowded, physiologically stressed and subject to disease. The abundance and diversity of aquatic insects upon which fish feed would be

lower below the dams than above, as recent surveys have shown (P. Crain, Lower Elwha S'Klallam Tribe, personal communication, August 1994).

Under the **Dam Retention** (with mitigation) alternative, some native anadromous fish would be able to surmount both the ladders at Elwha Dam and the trap and haul process at Glines Canyon Dam and would repopulate the middle and upper river. This might supply as much as 109,700 pounds of salmon biomass (all coho) and 1,800 pounds of nitrogen and phosphorus to the Elwha River.

Salmon and trout species would not be distributed in the river throughout the year as under pre-dam conditions, since only coho and steelhead have even a fair chance for restoration. Also, although wild coho and winter steelhead would be able to pass over the dams and populate a longer reach of the river, hatchery operations would be phased out and ultimately the overall numbers of salmon in the Elwha River would drop to below what the hatchery now produces.

Sediment and nutrients would still be trapped behind the reservoirs and would make the middle and lower Elwha River poor habitat to support any aquatic organisms, including fish. Water temperatures would remain elevated, and river habitat would be inundated by the reservoirs. The mainstream channel of the Elwha would meander less and form fewer important side pools and channels, and the estuary would remain reduced in size. Aquatic insect populations would likely continue to be less diverse and abundant.

Table 6. Potential carcass biomass (in pounds) contributed to Elwha River ecosystem from runs with at least fair restoration potential. (Elwha Report, p. 36)

	No Action	Dam Retention	Removal of Glines Dam	Removal of Elwha Dam	Proposed Action
Spring Chinook	0	0	35,000	35,000	35,000
Fall Chinook	0	0	135,700	135,700	140,400
Coho	0	109,700	113,700	113,700	117,600
Chum	0	0	0	0	236,000
Pink	0	0	0	0	261,200
Sockeye	0	0	0	27,600	27,600
TOTAL	0	109,700	284,400	312,000	817,800

Removal of Glines Canyon Dam with fish passage facilities installed at Elwha Dam, sediment and nutrients would be restored to the middle river, but would build up behind Elwha Dam until the reservoir fills. The estuary would remain smaller than under pre-dam conditions, but much of the other habitat for juveniles such as side channels, pools, and debris-covered areas, would be restored in the middle section of river. Removing the dam would introduce about 284,000 pounds of salmon carcass biomass and 4,770 pounds of nitrogen and phosphorus into the ecosystem (Elwha Report, p. 36). Pink and chum salmon would not be restored under this alternative which would represent a substantial 289,000 pound loss of late fall and winter biomass.

Stream flows in the middle river would approximate those under pre-dam conditions. Most of the temperature elevation is from Lake Mills, so removing it would reduce downstream temperatures to near normal. The reintroduction of sand and gravel would cause the river to meander over a wider range and to flood locally. A natural stream flow regime and distribution of sediment would not, however, return to the lower river and more than two miles of riverine habitat would continue to be inundated by Lake Aldwell.

Removal of Elwha Dam with fish passage facilities installed at Glines Canyon Dam would result in clear passage for sockeye salmon to migrate to the sea from their freshwater habitat at Lake Sutherland (the outlet from this lake is above Elwha Dam and below Glines Canyon Dam). This would add 27,600 pounds of carcass biomass to the Elwha River for a total of approximately 312,000 pounds. This means about 5,200 pounds of nitrogen and phosphorus would be introduced into the ecosystem.

Because Glines Canyon Dam would still be in place, sediment, nutrients and debris would be blocked from the middle and lower river and habitat would therefore remain in a degraded condition. Fish would experience passage losses from Glines trap and haul process and Lake Mills, and the pre-dam species distribution would not be reestablished.

Stream flows would continue to be altered by the presence of Glines Canyon Dam, and the channel would remain armored and stabilized, without side pools or channels. Water temperatures would remain elevated, and fish populations affected as a result.

The estuary would remain smaller than under pre-dam conditions, since sediment would be blocked by Glines Canyon Dam.

In the **Proposed Action**, the Elwha River would return to its natural dynamic flow. Sand and gravel would build up the riverbed, causing more frequent localized flooding and river course changes. Parts of the middle and lower river would return to their pre-dam braided and meandering condition. More than

five miles of riverine habitat would be returned for use by fish and aquatic organisms.

Salmon and trout would travel unimpeded through cool water and high quality habitat along the entire 45-mile Elwha River and its accessible tributaries. Nutrients, spawning gravels and woody debris would be distributed along the river's entire length. Side channels, pools and backwater areas would be available for juvenile rearing, as would a much larger estuary at the river's mouth.

In the long run, 10 runs of trout and salmon would return to the Elwha, distributing nutrients collected from the ocean in the form of fish biomass throughout the valley over the entire year. Wildlife species for whom food is scarce in the fall or winter would return as an abundant source of food becomes available. Other species for whom a source of food has been limiting are expected to move into the forest lands of the Olympic National Park which border the middle and upper river.

Removing both dams would introduce more than 800,000 pounds of salmon biomass and 13,000 pounds of nitrogen and phosphorus into the Elwha River ecosystem, more than twice the contribution any other alternative.

Cumulative Impacts

There are other impacts to the Elwha River ecology besides the two dams. These include and are discussed in appropriate sections of this document: logging, agricultural development, residential development, erosion control measures at the base of cliffs east of the mouth, flood control levees, in-river and marine fishing pressure and recreational use of the area. These all affect either the river flow, sediment loads, water quality or fisheries.

In terms of other similar ecosystems in the Pacific Northwest, many efforts are underway to salvage salmon runs, including habitat restoration and controls on fishing. However, because 83 percent of the Elwha River Basin lies within Olympic National Park boundaries and is in relatively pristine condition, full restoration of the Elwha River ecology is attainable.

Conclusions

Restoring the natural ecology depends on restoring natural stream flows and the native anadromous fisheries in the Elwha River. Taking action as proposed would accomplish both and add about 800,000 pounds of biomass in the form of salmon and trout to the river. Removing only Glines Canyon Dam would partially restore both, but would add about 500,000 fewer pounds of fish biomass to the upper and middle Elwha than removing both dams. Removing only Elwha Dam would not restore natural flows or transport of nutrients, woody debris and gravel the fish require to be self-sustaining. However, it would add fish



biomass to the middle river, and mitigation measures installed at Glines Canyon Dam would result in some salmon in the upper river. Removing Elwha Dam only would add about 500,000 fewer pounds of fish biomass to the river than removing both dams. Installing mitigation measures on both dams would not return the river to its original flow and transport regime, but would provide about 100,000 pounds of salmon and trout biomass to wildlife species along the mid and upper Elwha. Taking **No Action** would continue to keep all salmon and seagoing trout from the middle and upper Elwha, and would prevent the Elwha River from returning to natural flow, sediment transport and water quality conditions.

*References and
Appendix*



*Glines Canyon Dam Penstock, no date.
(Clallam County Historical Society)*

Consultation and Coordination

History of Public Involvement

The Federal Energy Regulatory Commission indicated its intent to write an environmental impact statement on whether to issue licenses for the two dams through a "Notice of Intent" in the Federal Register on August 17, 1989.

Formal scoping, or early effort to involve agencies and the general public, was initiated in December 1989. FERC staff contacted intervenors, state and federal agencies, Native American organizations and members of the public who were potential sources of information. They held two public scoping meetings in Washington State to identify issues and solicit comments; then reviewed public, tribal and agency comments relating to the EIS scope.

Based on these comments, FERC staff wrote a scoping document which identified objectives and issues. It also identified two "principal" alternatives: **Dam Retention** (with mitigation as described under the applicant alternative in the FERC staff report), and eliminated the **No Action** alternative as unreasonable.

A draft EIS was distributed to affected agencies and interested members of the public in February 1991, and a notice of its general availability was published in the Federal Register March 1, 1991.

Comments on the draft EIS were reviewed and responded to in a two-volume document which would normally have been FERC's final EIS. This was later renamed "Draft Staff Report" and was never made available to the general public. The Draft Staff Report was dated March 1993, and made available to the Department of the Interior to help prepare the Elwha Report as mandated by Congress.

An October 1993 open house to discuss the Elwha Report in Port Angeles was attended by about 200 people. Staff from the agencies responsible for preparing the Elwha Report (Departments of the Interior and Commerce and the Lower Elwha S'Klallam Tribe) answered questions and recorded comments from those attending. A draft of the Elwha Report was available for public review and comment from October 4 to November 8, 1993. In some cases, the Elwha Report was modified as a result of the comments, and in others, Appendix M of the final document responded to the comments directly. The Elwha Report was finalized in January 1994 and submitted to Congress in June 1994.

Lists of those agencies, organizations and individuals who received copies of the FERC draft EIS can be found in that document.

The National Park Service has prepared this draft EIS to assist the secretary of the interior in deciding whether to remove the two dams. NPS has published a notice of intent in the Federal Register describing the two-EIS approach (see Introduction in this document). Two public meetings to hear comments on this supplement and the material DOI is adopting are scheduled in Seattle and Port Angeles. There will also be a 60-day public review and comment period so all interested and affected parties can submit written comments.

Concurrently, scoping for the second, "Implementation" EIS will begin. Public scoping sessions before the EIS is written, public meetings after the draft EIS is available and a 60-day review and comment period on the draft EIS will be part of the public input process for this second EIS.

Both of the EIS's prepared for the DOI will depend heavily on analysis provided by federal agencies and the Lower Elwha S'Klallam Tribe who are considered "cooperating" agencies under the National Environmental Policy Act. These agencies include: the U.S. Fish and Wildlife Service (USFWS), U.S. Bureau of Indian Affairs (DOI), U.S. Bureau of Reclamation (DOI), the U.S. Army Corps of Engineers, and the Lower Elwha S'Klallam Tribe. These agencies have provided extensive review and comment on this Supplement, and will conduct the bulk of analyses required for the Implementation EIS. The National Park Service is responsible for the coordination and writing of both EIS's.

List of Preparers

NATIONAL PARK SERVICE PREPARERS

Name	Title/Responsibility	Education	Experience
Sarah Bransom	Supervisory Natural Resource Specialist - NPS oversight, contact manager	M.S., Environmental Planning and Community Development; B.A., Political Science/ Environmental Studies	3 years NPS 12 years other federal experience
J.R. Kirkaldie	Recreation Planner - mapping, visual aids	B.S., Environment and Resource Management - Land Use	2 years NPS 1 year state experience
Lisa Norby	Natural Resource Specialist	M.E.P.M. candidate, Environmental Policy and Management; M.S., Geology; B.S., Geology	1 year NPS 13 years private
Ron West	Natural Resource Specialist	B.S., Wildlife Biology	11 years NPS
Frank Williss	Historian	M.A., History; B.A., History	16 years NPS
Brian Winter	Elwha Restoration Project Manager - fisheries section	Ph.D., Fisheries; M.S., Fisheries; B.S., Natural Resources Planning and Interpretation	1 year NPS 5 years National Marine Fisheries Service 8 years private
Janet Scharf	Visual Information Specialist - NPS Publishing Coordinator/ Design Assistant	M.S., Botany; B.A., Anthropology	22 years NPS

CONSULTANTS

Name	Title/Subject Matter	Affiliation
Heidi West	Team Captain - NEPA oversight, lead writer; existing conditions and impact assessment on fisheries, recreation	Jones & Jones, TQ NEPA
Keith Larson	Principal for Jones & Jones - project and team oversight	Jones & Jones
Charles Scott	Project Manager - coordination of all consultants	Jones & Jones
Maggi Johnson	Document Coordination	Jones & Jones
Daniel White	Document Editor	Jones & Jones
Elizabeth Hansford	Document Layout	Jones & Jones

ILLUSTRATIONS (Courtesy of Olympic National Park)

Laurel Black	Artist - all drawings except illustrations on pp. 13, 33, 50, 64, 65, 72, 76.	Laurel Black Graphic Design
Carole Kahler	Artist - illustrations on pp. 64, 65, 72, 76.	Freelance Artist

List of Recipients

Federal Agencies, Committees and Laboratories

Department of Agriculture
U.S. Forest Service
Department of Defense
U.S. Coast Guard
U.S. Army Corps of Engineers
Department of Energy
Federal Energy Regulatory Commission
Department of the Interior
U.S. Bureau of Indian Affairs
U.S. Bureau of Land Management
U.S. Bureau of Mines
U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
U.S. Geological Survey
National Park Service
Environmental Protection Agency
Federal Emergency Management Agency
General Accounting
House Fisheries and Wildlife Committee
House Natural Resource Staff
Idaho National Engineering Laboratory
National Biological Survey
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
President's Council on Sustainable development
Soil Conservation Service

States

State of California
Department of Fish and Game

State of Maine
Department of Natural Resources

State of Montana
Environmental Quality Control

State of New York
Power Authority

States (continued)

State of Washington
Department of Community development
Department of Ecology
Environmental Council
Department of Fish and Wildlife
Department of Health
Department of Natural Resources
Department of Trade and Economics
Department of Transportation
Governor's Office
Historic Preservation Office
Parks and Recreation Commission
State Energy Office
State Grange
State Sportsman's Council

State of Wisconsin
Department of Natural Resources

Congresspeople

Honorable Maria Cantwell
Honorable Norm Dicks
Honorable Jennifer Dunn
Honorable Diane Feinstein
Honorable Thomas Foley
Honorable Slade Gorton
Honorable Jay Inslee
Honorable Mike Kreidler
Honorable Jim McDermott
Honorable Patty Murray
Honorable Al Swift
Honorable Jolene Unsoeld

County and Local Governments

City of Port Angeles
Clallam-Bay-Sekiv Chamber of Commerce
Clallam County-Department of Community development
Clallam County-Economic development
Clallam County Grange
Clallam County Historic Society
Clallam County PUD
Forks Chamber of Commerce
Port Angeles Chamber of Commerce

County and Local Governments (*continued*)

Port Angeles Water
Port Townsend Chamber of Commerce
Sequim Chamber of Commerce

Organizations and Business

Adele McCall
American Electric Power Company
American Fisheries Society
American Rivers
Analytical Services Inc.
Agriculture
Atlantic Salmon Federation
Balance Hydrologics
Battelle Northwest
Bonneville Power Administration
CH2M Hill
CMC Heartland Partners
Carolina Denver and Light Company
Chinook Engineering
Chinook Northwest Inc.
CRITFC
Columbia River Intertribal Fish Commission
Consulting Engineers Inc.
Crescent West Inc.
Cutter and Stanfield
Daishowa America Inc.
Damn the Dams
Daniel J. Evans Associates
Decision Data
Dry Creek Grange #644
Dry Creek Water Association
Ebasco Services
Edison Electric Institute
Elwha Place Homeowners Assoc.
Enserch Environmental Corp.
Evergreen Legal Services
First Federal Savings and Loan
Fish Pro
Fisheries Dept.-Shoshoni-Bannock Tribe
Fletcher Far Ayotte
Friends of the Earth
Geo Engineers
Glen Canyon Environmental Studies
Goldman Environmental Foundation
Grand Canyon Trust
Green Crow Partnership
Hydro-Triad Limited
ITI Rayonier Inc.

Organizations and Business (*continued*)

Infotec Research Inc.
International Rivers Network
Jamestown S'Klallam Tribe
Jones and Jones
Keller Rohrbock
Klahhane Club
Lake Crescent Lodge
Land & Lane Associates
Living Trust
Log Cabin Resort
Long Live the Kings
Lower Elwha Fisheries
Lower Elwha S'Klallam Tribe
Lyndon Johnson NHP
Makah Indian Tribe
Metropolitan Water District of Southern California
Meyer Resources, Inc.
Montesano Vidette
Monumental Creek
NW Conservation Act Coalition
National Park Foundation
National Parks & Conservation Association
National Wildlife Federation
North Olympic Land Trust
North Olympic Salmon Coalition
Northrop Devine and Tarbell
Northwest Chapter Wilderness Watch
Northwest Power Planning Council
Northwest Rivers Council
Olympic National Forest
Olympic National Park
Olympic National Resources Center
Olympic Outdoor Sportsmen's Association
Olympic Park Associates
Olympic Park Institute
Olympic Peninsula Audubon
Olympic Raft & Guide Service
Outside Connection
Pacific Hydro Consulting Group
Pacific Northwest Trail Association
Pacific Power and Light Company
Pacific Rivers Council
Pack Creek Ranch
Parametrix
Perkins Cole
Point No Point Treaty Council
Port Angeles-Victoria Visitor Bureau
Port Gamble S'Klallam Tribe
Preston, Gates, Ellis & Raivelas Meeds
Preston, Thorgrimson, Shidler, Gates and Ellis

Organizations and Business (continued)

Preston, Gates and Ellis
Puget Sound Power and Light Company
Puyallup Fisheries
R. W. Beck and Associates
Radin and Associates Inc.
Rainier Evergreen Inc.
Recreational Equipment Inc.
Rescue Elwha Area Lakes
Ridolfi Engineering & Associates
Rio Grand Restoration Project
Rivers Network
Robbin B. Sotir & Associates
Seattle Audubon Society
Sierra Club
Sierra Club Legal Defense Fund
Skokomish Indian Tribe
Smith, Brucker, Winn & Elhert
Sol Duc Hot Springs Resort
Stoel Rieves et al
Stone and Webster
Summit Technology
TQ NEPA
Tacoma Public Utilities
The Mountaineers
The Olympians Inc.
The Rockey Company
The Trust for Public Land
The Wilderness Society
Triangle and Associates
Trout Unlimited
Trumpeter Swan Society
U.S. Savings Bank of Washington
Van Ness Feldman
Washington Appellate Defenders
Washington Wilderness Coalition
Wilkinson Barker
Winthrop, Stimson, Putman and Roberts
Yakima Nation
NOLS

Local Libraries

Aberdeen Timberland Branch Library
Bellevue Branch Library
Bremerton Branch Library
Clallam Bay Branch Library
Forks Branch Library
Holland Library
Kirkland Branch Library

Local Libraries (continued)

Kingston Branch Library
Mansfield Library
Port Angeles Branch Library
Redmond Branch Library
Sequim Branch Library
Port Townsend Public Library
Renton Public Library
Seattle Public Library
Tacoma Public Library
University of Washington
William G. Reed Branch Library

Academic Institutions

Colorado State University
Humboldt State University
Michigan State University
Northwestern University
Pitzer College
The Evergreen State College
University of California
University of Colorado
University of Montana
University of Washington
University of Wyoming
Williams College

Newspapers

Associated Press
Bellingham Herald
East County News
Everett Herald
Forks Forum
High Country News
Hydrowire Newsletter
Jimmy Come Lately Gazette
McClatchy Newspaper
Out West Newspaper
Peninsula Daily News
Peninsula Gateway News
Port Townsend Leader
San Francisco Chronicle
Seattle P.I.
Seattle Times
Sequim Gazette
Shelton-Mason County Journal
Spokesman Review

Newspapers (*continued*)

Tacoma News Tribune
The Citizen News
The Daily News
The Daily World
The Olympian
The Sun
USA Today
UPI

Magazines

Backpacker
National Fisherman
National Geographic Society
Outside Magazine
Pacific Northwest Magazine
Popular Mechanics
Seattle Weekly
Signpost Magazine
Sunset Magazine
The Christian Science Monitor
U.S. Weekend Magazine

Radio/TV Stations

FSOH-FM
KAPY
KAYO
KBAM Radio
KBWK Radio
KGHO
KGY Radio
KING TV and Radio
KIRO TV and Radio
KJR Radio
KKMO Radio
KMAS
KMPS Radio
KOMO Radio and TV
KONP
KPLU
KQEU
KRKO
KSTW TV
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KVOS TV
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National Public Radio
Northland Cable News



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Glossary

aggradation - The build-up of river sediment by natural deposition.

anadromous fish - Species of fish such as salmon, which hatch in freshwater, spend a large part of their lives in the ocean, and return to freshwater to reproduce.

angler - A person who fishes with a rod and reel.

armoring - Progressive removal of finer grained sediments from a streambed leaving a layer of coarser sediment that is less easily eroded.

attenuate - To weaken or reduce the force of something such as flood waters.

avoided costs - Money that is not spent because something is done differently.

bedload - A mobile layer of coarse sediment (sand, gravel, cobble or rock fragments) transported along the bottom of a stream.

biomass - The total amount of living organisms of one or more species in an animal community, often expressed as weight per unit of volume or area.

brood - Young animals or fish born or hatched at one time.

brood stock - Animals or fish with a common origin that are kept for breeding.

brood year - Animals or fish born or hatched during one year.

cfs - Cubic feet per second, a unit of measurement for flowing water.

DOI - Department of the Interior, the federal department preparing this supplement to analyze the impacts of restoring the anadromous fisheries and ecosystem of the Elwha River. The National Park Service is a DOI bureau and the lead agency in the preparation of this EIS.

ecology - The study of the interrelationships between organisms and their environments.

ecosystem - A community of living organisms interacting with one another and with their physical environment, such as a forest, pond or estuary.

ethnohistory - The study of the past ways of life of a group of people or culture.

Eicher screens - Experimental technology to minimize fish injuries that places a screen within a penstock and uses water velocity to carry juvenile salmonids past the screen and into a bypass pipe, thus avoiding turbines.

EIS - Environmental Impact Statement. The National Environmental Policy Act of 1969 requires that an environmental impact statement be prepared to evaluate the potential environmental affects of major federal actions. An EIS identifies and analyzes activities that might affect the human and natural environment.

electric weir - A structure that uses electric current to prevent entry by fish into an area.

estuary - Area near the mouth of a river where fresh and saltwater intermix.

FERC - Federal Energy Regulatory Commission, the federal agency authorized to issue licenses to operate and maintain nonfederal hydroelectric projects. This EIS supplement is tiered from the FERC Draft Staff Report and has incorporated most of the document by reference.

fish ladder - An ascending structure of intervening pools of water that is built to allow fish to migrate upstream.

floodplain - Land adjacent to a river that is periodically subject to flooding.

food chain - The succession of organisms in a community according to the order of predation from one to another, usually lower member, as a source of food.

forebay screens - A structure placed in the forebay of a powerhouse to discourage adult fish from being attracted to the powerhouse's water discharge.

hydroelectric - Generating electricity by conversion of the energy of running water.

indigenous - People or animals that live or naturally occur in a specific area or environment.

intertidal - The area between the extremes of high and low tide.

JFWA - Joint Fish and Wildlife Agencies; this includes the U.S. Fish and Wildlife Service, Bureau of Indian Affairs, National Park Service, National Marine Fisheries Service, Washington Department of Wildlife, Point No Point Treaty Council, and the Lower Elwha S'Klallam Tribe.

juvenile - Refers to any fish that is not adult. It is the life stage of salmon and trout living in freshwater before entering the ocean.

kelt - Adult anadromous fish which spawn in freshwater and return to the ocean. They are called kelts upon their return to the sea.

levee - A dike or embankment of earth or concrete that is used to prevent water from overflowing the river channel during times of flooding.

meander - Winding course of a river.

mitigation - Activities that will lessen or eliminate adverse environmental impacts.

morphology - The three dimensional characteristics or form of a feature such as a river channel.

MW - Megawatt, a unit of electrical energy.

native anadromous fisheries - The populations of anadromous fish that historically inhabited a river.

NEPA - National Environmental Policy Act, a 1969 federal law that requires the consideration of environmental effects of proposed federal actions.

nonpoint - Refers to the source of sediment or pollution (such as runoff from a field) that cannot be linked to a discrete, identifiable source.

outmigration - The movement of juvenile fish from freshwater to the sea.

palustrine - Nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens, or nonvegetated wetlands less than 20 acres in size.

passerines - Songbirds.

polychlorinated biphenyls (PCBs) - Hazardous chemical compound that may be present in electrical power transformers.

Ranney well - A method of collecting groundwater through buried perforated pipes often placed under riverbeds.

raptors - Birds of prey such as red tailed hawks and bald eagles.

real costs - Baseline costs that do not account for inflation.

red tide - A bloom of microscopic marine organisms (various dinoflagellates). Shellfish eaten during red tide events can be poisonous to humans.

residualism - Typically refers to anadromous trout or salmon juveniles that remain in fresh water instead of migrating to the ocean.

rip rap - Large angular stones that are used to build or strengthen river banks, and structures such as dikes, levees and spits.

riparian - Vegetation found along waterways and shorelines that is adapted to moist growing conditions and occasional flooding.

salmonid - Fish within the family Salmonidae, e.g. salmon and trout.

self-sustaining - Capable of maintaining oneself independently.

sessile - Organisms that are permanently attached or fixed to the bottom or substrate.

setback levee - A levee that is located away from a stream or river, typically to minimize impacts to the floodplain.

shoals - Shallow area in a body of water.

smolt - A young anadromous salmonid migrating downstream that has undergone the physiological changes necessary to survive in salt water.

spawn - The deposition and fertilization of eggs in organisms such as salmon and trout.

spawning gravels - Gravel of suitable size and shape in a stream where salmonids lay their eggs.

species - A group of individual plants or animals (including subspecies and populations) that have common characteristics and interbreed.

spillway - A channel for overflow of water, as from a reservoir.

substrate - The base upon which plants or animals live or grow.

subtidal - Area of water below the low tide level.

successional forests - Stages of a forest that evolve from bare ground to climax community.

trap and haul - Collecting or trapping and transporting fish upstream for reproductive purposes. This is commonly done with trucks where structures such as dams have impeded fish migration.

turbidity - Visible undissolved solid material suspended in water. Increasing the turbidity of the water decreases the amount of light that can be penetrated.

turbine - A rotary engine actuated by the flow of a fluid that is subject to pressure in contact with vanes located on a rotating shaft.

USBOR - United States Bureau of Reclamation.

USGS - United States Geological Survey.

watershed - The area drained by a river system.

WDFW - Washington Department of Fisheries and Wildlife.

wetland - Lowland area such as a swamp or marsh that is periodically saturated with water and supports vegetation adapted to wet areas.



Appendix

Public Law 102-495 • Elwha Restoration Act

PUBLIC LAW 102-495—OCT. 24, 1992

106 STAT. 3173

Public Law 102-495
102d Congress

An Act

To restore Olympic National Park and the Elwha River ecosystem and fisheries in the State of Washington.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Elwha River
Ecosystem and
Fisheries
Restoration Act.
Conservation.

SECTION 1. SHORT TITLE.

This Act may be referred to as the “Elwha River Ecosystem and Fisheries Restoration Act”.

SEC. 2 DEFINITIONS.

For the purposes of this Act:

(a) The term “Administrator” means the Administrator of the Bonneville Power Administration.

(b) The term “Commission” means the Federal Energy Regulatory Commission.

(c) The term “electric power” means electric peaking capacity or electric energy or both.

(d) The term “Elwha Project” means the Elwha River Hydroelectric Project, Federal Energy Regulatory Commission Project Number 2683, including appurtenant works and project lands, located on the Elwha River in Clallam County, Washington.

(e) The term “Glines Project” means the Glines Canyon Hydroelectric Project, Federal Energy Regulatory Commission Project Number 588, including appurtenant works and project lands, located on private and public lands both within and without the exterior boundaries of Olympic National Park on the Elwha River in Clallam County, Washington.

(f) The term “local industrial consumer” means the owner of the pulp and paper mill located on Ediz Hook in Port Angeles, Washington, that, on the date of enactment of this Act, receives and consumes the electric power produced by the Projects, or its successors or assignees.

(g) The term “local preference customer” means Port Angeles City Light.

(h) The term “owner” means the current owner of the Projects or its successors or assignees, but shall not mean the secretary, the United States, or any other entity acquiring title to the Projects or features thereof pursuant to the terms of this Act. (i) The term “Park” means Olympic National Park.

(j) The term "Project" or "Projects" means either or both the Elwha Project and the Glines Project, including project works and appurtenant lands.

(k) The term "project replacement power" means electric power delivered to the local industrial consumer to replace losses of electric power generation from the Projects following their acquisition by the secretary pursuant to this Act, in an amount not to exceed 172.088 gigawatthours of energy in any year.

(l) The term "secretary" means the secretary of the interior.

(m) The term "State" means the State of Washington, including its agencies and departments.

SEC. 3 ACQUISITION OF PROJECTS.

Effective date

(a) Effective sixty days after submission to the Congress of the report referred to in section 3(c), the secretary is authorized to acquire the Elwha and Glines Canyon Projects, and all rights of the owner and local industrial consumer therein, subject to the appropriation of funds therefor: *Provided*, That the secretary shall not acquire the projects unless he has determined pursuant to subsection (c) that removal of the Project dams is necessary for the full restoration of the Elwha River ecosystem and native anadromous fisheries and that funds for that purpose will be available for such removal within two years after acquisition.

(b) The consideration for acquisition of the Projects shall be \$29.5 million and no more, to be paid by the secretary to the owner and local industrial consumer at the time of acquisition, and shall be conditioned on a release of liability providing that all obligations and liabilities of the owner and the local industrial consumer to the United States arising from the Projects, based upon ownership, license, permit, contract, or other authority, including , but not limited to, project removal and any ecosystem, fish and wildlife mitigation or restoration obligations, shall, from the moment of title transfer, be deemed to have been satisfied: *Provided*, That the United States may not assume or satisfy any liability, if any, of the owner or local industrial consumer to any federally recognized Indian Tribe nor shall such liability to the Tribe, if any, be deemed satisfied without the consent of such Tribe.

Reports

(c) The secretary shall prepare a report on the acquisition of the Projects and his plans for the full restoration of the Elwha River ecosystem and the native anadromous fisheries and submit such report on or before January 31, 1994, to the Appropriations Committees of the United States Senate and the United States House of Representatives, as well as to the Committee on Energy and Natural Resources of the Senate and the Committees on Energy and Commerce, Interior and Insular Affairs, and Merchant Marine and Fisheries of the United States House of Representatives. The report shall contain, without limitation:

(1) The precise terms of acquisition of the Projects, with an analysis of the costs, in addition to the consideration set out in section 3(b), and potential liabilities and benefits, if any, to the Federal Government resulting from the acquisition and all other actions authorized under this Act;

(2) Alternatives, in lieu of dam removal, for the restoration of the Elwha River ecosystem and the native anadromous fisheries and wildlife of the Elwha River Basin, consistent with the management plan of the Park, the rights of any Indian tribe secured by treaty or other Federal law, and applicable State law. The report shall include feasibility studies for each alternative considered and a definite plan for removal. Such definite plan shall include the timetable after conveyance for removal of the dams and the plans for removal and disposal of sediment, debris,

and other materials consistent with all applicable environmental laws and a detailed explanation of all costs of removal. In conducting the feasibility studies and in the preparation of the definite plan, the secretary is authorized to use the services of any Federal agency on a reimbursable basis and the heads of all Federal agencies are authorized to provide such technical and other assistance as the secretary may request. For each alternative considered, the secretary shall estimate total costs, environmental risks and benefits, the potential for full restoration of the Elwha River ecosystem and native anadromous fisheries, and the effect on natural and historic resources (together with any comments made by the Advisory Council on Historic Preservation for any properties which are listed, or eligible for listing, on the National Register of Historic Places).

(3) Specific proposals for management of all lands or interests therein acquired pursuant to this Act which are located outside the exterior boundaries of the Olympic National Park. The secretary shall specifically address the suitability of such lands, or portions thereof, for addition to the National Wildlife Refuge System; National Park System; transfer to the Lower Elwha Klallam Tribe in trust for tribal housing, cultural, or economic development purposes in accordance with a plan developed by the Lower Elwha Klallam Tribe in consultation with the secretary; and development and use by the State. Upon acquisition, all lands and interests therein within the exterior boundaries of the Park shall be managed pursuant to authorities otherwise applicable to the Park. For the purposes of protecting the Federal investment in restoration, that portion of the river outside the Park on which the Federal Government will acquire both banks shall, upon such acquisition, be managed in accordance with the declared policy of section 1(b) of Public Law 90-542, except that modifications necessary to restore, protect, and enhance fish resources and to protect the existing quality of water supplied from the river are hereby authorized.

(4) Specific proposals and any Federal funding and the availability of that funding that may be necessary to protect the existing quality and availability of water from the Elwha River for municipal and industrial use from possible adverse impacts of dam removal.

(5) Identification of any non-Federal parties or entities, excluding Federally recognized Indian tribes, which would directly benefit from the commercial, recreational, and ecological values that would be enhanced by the restoration of the Elwha River ecosystem and fisheries, if the secretary believes that such parties or entities should assume some portion of the cost involved in the restoration, together with the specific cost-share provisions which the secretary deems necessary and reasonable.

(d) In preparing his report, the secretary shall consult with appropriate State and local officials, affected Indian tribes, the Commission, the Environmental Protection Agency, the secretary of Energy, the Administrator, the Pacific Northwest Power Planning Council, the secretary of Commerce, and the Advisory Council on Historic Preservation, as well as interested members of the public. In addition, the secretary shall afford an opportunity for public comment on the report prior to its submission to the Congress.

(e) Upon the appropriation of the sum provided for in section 3(b) for the acquisition of the Projects and the determination that dam removal is necessary, the owner and local industrial consumer shall convey to the United States, through the secretary, title to the Projects, including all property and all other rights and interests. Upon such conveyance and payment of the consideration as provided in section 3(b), and without further action by the United States, title shall transfer and vest in the United States. The

owner and local industrial consumer shall be released from any further liability, to the United States, as provided in section 3(b), and the acquisition from the owner and local industrial consumer shall be deemed to be completed.

SEC. 4. ECOSYSTEM AND FISHERIES RESTORATION.

Effective date.

(a) Effective sixty days after submission of the report referred to in section 3(c) and following the conveyance in section 3(e), the secretary is authorized and directed, subject to the appropriation of funds thereof, to take such actions as are necessary to implement—

(1) the definite plan referred to in section 3(c)(2) for the removal of the dams and full restoration of the Elwha River ecosystem and native anadromous fisheries;

(2) management of lands acquired pursuant to this Act which are located outside the exterior boundaries of the Park; and

(3) protection of the existing quality and availability of water from the Elwha River for municipal and industrial uses from possible adverse impacts of dam removal.

(b) The definite plan referred to section 3(c)(2) must include all actions reasonably necessary to maintain and protect existing water quality for the City of Port Angeles, Dry Creek Water Association, and the industrial users of Elwha River water against adverse impacts of dam removal. The cost of such actions, which may include as determined by the secretary, if reasonably necessary, design, construction, operation and maintenance of water treatment or related facilities, shall be borne by the secretary. Funds may not be appropriated for removal of the dams, unless, at the same time, funds are appropriated for actions necessary to protect existing water quality.

(c) Nothing in this section shall be construed as an entitlement for which a claim against the United States may be made under the Tucker Act.

SEC. 5. PROJECT OPERATION AND REPLACEMENT POWER.

(a) Notwithstanding any other provision of law, neither the Federal Energy Regulatory Commission nor any other agency of the Federal Government shall have the authority or jurisdiction to issue a permanent license or similar order with respect to either Project prior to conveyance as provided in section 3(e), except that the Commission shall have jurisdiction under the Federal Power Act and is hereby authorized and directed to issue or maintain in effect annual licenses or authorizations for both Projects, authorizing continued operation of both Projects by the owner and local industrial consumer, such operation to be under such terms and conditions and in accordance with such practices as existed on September 1, 1992, until (1) the date the secretary has acquired title to the Projects or (2) if the secretary's report required in section 3(c) does not provide for dam removal, five years after the expiration of the current annual license or authorization then in effect, after which time the Commission shall have authority under the Federal Power Act to issue appropriate licenses with respect to such Projects to the extent the Commission has jurisdiction over such Projects under such Act on the date of enactment of this Act.

(b) To ensure the availability of adequate electric power supplies to the operating facilities of the local industrial consumer, the Administrator shall, following acquisition of the Projects pursuant to this Act, deliver all project replacement power required by the operating facilities of the local industrial consumer through the local preference customer at a rate equal to the priority firm rate, or the rate which is then the equivalent of the priority firm rate if that designation is no longer used by the Administrator, as

such rate is fixed by the Administrator from time to time, without regard to any new large single load determinations or similar factors. The local industrial consumer shall pay the local preference customer for such project replacement power at the same rate as all other industrial consumers of the local preference customer.

(c) Upon conveyance of the Projects to the United States, the secretary shall maintain the dams in a safe condition for the period prior to their removal.

SEC. 6. LEASE OF FEDERAL LANDS.

(a) **LEASE OF LANDS TO THE CITY OF PORT ANGELES.**—After the secretary makes the determination to remove the dams and actually acquires the projects and funds are appropriated for such conveyance and removal, the secretary is authorized to issue a lease to the City of Port Angeles, Washington, for those lands situated on Ediz Hook, Clallam County, Washington, currently leased to the City under Lease No. DOT-CG123-4811-72, dated April 4, 1972, as amended, except for that parcel of land described in subsection (b)(2). Such lease shall be issued pursuant to the Act of June 14, 1926, as amended (43 U.S.C. 869), for a period of 99 years, beginning on a date to be determined by the secretary, without right of patent.

(b) **LEASE OF LANDS TO THE LOWER ELWHA KLALLAM TRIBE.**—

(1) After the secretary makes the determination to remove the dams and actually acquires the Projects and funds are appropriated for such conveyance and removal, the secretary is authorized to lease to the Lower Elwha Klallam Tribe that parcel of land situated on Ediz Hook, Clallam County, Washington, described in paragraph (2) for the purposes of the construction and operation of a tribal cultural facility, such as a longhouse or a museum, and associated interpretive and parking facilities. Such lease shall be issued pursuant to the Act of June 14, 1926, as amended (43 U.S.C. 869), for a period of ninety-nine years beginning on a date determined by the secretary, without right of patent.

(2) The parcel of land to be leased to the Lower Elwha Klallam Tribe is that parcel of land lying south of the existing roadway and extending southward to the southern boundary of the land currently leased to the city of Port Angeles (Lease No. DOT-CG13-4811-72, dated April 4, 1972, as amended) and beginning at the north-south line 200 feet east of the western boundary of Out Lot 6 and running easterly 600 feet to the north-south line 300 feet west of the eastern boundary of Out Lot 6.

(3) In addition to the general terms and conditions applicable under the Act of June 14, 1926, as amended (43 U.S.C. 869), the lease to the Tribe shall be subject to the following terms and conditions:

(A) There shall be public access to the beach along the south side of the parcel at all times.

(B) The City of Port Angeles shall have the right to construct and maintain a waterfront trail adjacent to the existing roadway along the north side of the parcel, the location of which shall be determined in conjunction with the secretary.

(C) Parking facilities on the parcel shall be open to the public at all times.

(4) In addition to the terms and conditions described in this section for the leases to the City and the Tribe, the secretary shall incorporate by reference into each lease the Agreement entered into on August 11, 1992, between the City and the Tribe regarding the use of the adjacent leaseholds.

SEC. 7. TRIBAL LAND ACQUISITION AND DEVELOPMENT.

(a) After the secretary makes the determination to remove the dams and actually acquires the Projects and funds are appropriated for such conveyance and removal, the secretary is authorized to acquire by purchase, and hold in trust in reservation status for the benefit of the Lower Elwha Klallam Tribe, lands in Clallam County, Washington, for housing, economic development, and moorage for the Tribal commercial fishing fleet.

Appropriation
authorozation.

(b) There is authorized to be appropriated an amount not to exceed \$4,000,000 to carry out the land acquisition purposes of this section.

SEC. 8. SAVINGS.

(a) Nothing in this Act shall abridge or modify existing rights to Elwha River water.

(b) Nothing in this Act shall affect the rights of any Indian Tribe secured by Treaty or other law of the United States.

(c) This Act does not modify any of the Administrator's obligations or require the Administrator to take any actions regarding the protection, mitigation, or enhancement of fish and wildlife or expand those provided for under the Pacific Northwest Power Planning and Conservation Act, Public Law 96-501. Notwithstanding any other provision of law, the Administrator shall not be required to make any expenditures from the Bonneville Power Administration fund for the operation, maintenance, rehabilitation, improvement, or removal, breach, or bypass of the Projects.

SEC. 9. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the secretary of the interior for expenditure through the Assistant secretary for Fish, Wildlife, and Parks and to the secretary of Commerce for expenditure through the National Marine Fisheries Service such sums as may be necessary to carry out the purposes of this Act: *Provided*, That such authorization shall not become effective until sixty days following submission of the report provided for in section (3)(c) of this Act.

Effective date.

Approved October 24, 1992.

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